ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

MAY 1956

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what lies ahead for

GERMANIUM

How Hydrosealing cuts the cost of pumping abrasives

Because their close clearances are protected by a small flow of seal liquid, Hydroseal pumps maintain their initial high efficiency throughout pump life. Therefore, since over-size pumps & motors are not needed as allowance for abrasive wear, you can save 1/3 to 1/2 in power cost.

Besides this saving, there is marked economy in the fact that the wearing parts of Hydroseal Slurry and Sand pumps are of moulded-to-fit Maximix Rubber or Neoprene. These parts outlast their metal equivalents many, many times, and are easily, cheaply replaced. Since abrasives larger than 4 mesh don't bounce off but tend to tear rubber, the wearing parts of Hydroseal Dredge pumps are of tough alloy iron.

In the interest of spending less for better pumping, ask us about Hydroseals for your requirements.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—259 E. Lancaster Ave., Wynnewood, Pa.
Representatives throughout the World

HYDROSEAL *advantages*

Reduce power costs 1/3 to 1/2

•

Achieve maximum head

•

Install for suction lift

•

Operate with extreme inlet pressure

•

Work in series

•

Compensate for changes in volume and head by automatic speed control

ASH

HYDROSEAL and CENTRISEAL

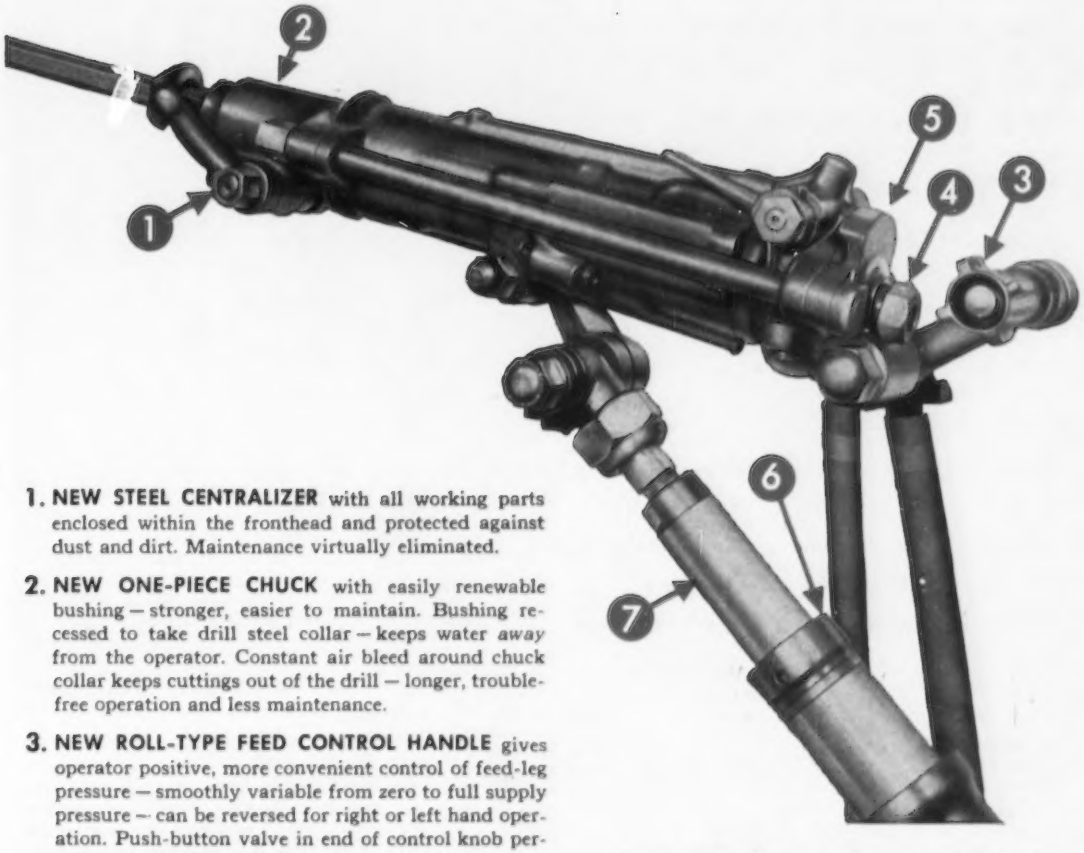
SAND, SLURRY & DREDGE PUMPS

MAXIMIX RUBBER PROTECTED

new JR-38B JACKDRILL

has 7 improved features

for EASIER OPERATION & LESS MAINTENANCE



1. **NEW STEEL CENTRALIZER** with all working parts enclosed within the fronthead and protected against dust and dirt. Maintenance virtually eliminated.
2. **NEW ONE-PIECE CHUCK** with easily renewable bushing — stronger, easier to maintain. Bushing recessed to take drill steel collar — keeps water *away* from the operator. Constant air bleed around chuck collar keeps cuttings out of the drill — longer, trouble-free operation and less maintenance.
3. **NEW ROLL-TYPE FEED CONTROL HANDLE** gives operator positive, more convenient control of feed-leg pressure — smoothly variable from zero to full supply pressure — can be reversed for right or left hand operation. Push-button valve in end of control knob permits instant relief of feed pressure.
4. **NEW EASY WATER TUBE REPLACEMENT** water tube can be replaced without disassembling the Jackdrill by removing backhead plug.
5. **NEW STOPER CONVERSION** permits Jackdrill backhead to be replaced with a conventional Stopehamer backhead. Simplifies parts inventory and maintenance wherever Jackdrills and Stopehamers are used on the same job.
6. **NEW EASIER DISMANTLING** of feed leg — saves maintenance down-time.
7. **NEW TELESCOPIC FEED LEG** is 10 pounds lighter in weight than previous design — makes Jackdrill easier to handle and transport.

WITH these new features, the I-R Universal Jackdrill is now better than ever — setting new standards of ease and economy — *it will stay underground.* It's not just a Jackhamer-Jackleg combination, but a completely integrated Jackleg Drill, with single air hose connection and all operating controls centralized on the drill backhead. Ask your Ingersoll-Rand representative for complete information on the time-saving, cost-saving features of the new and improved JR-38B Jackdrill. 5-409

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ENGINEERING AND MINING JOURNAL

90th YEAR OF PUBLICATION

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LETTERS

Rare Earths in Steel

Dear Sir:

In the February 1956 issue of *Engineering & Mining Journal*, on page 111, you give some figures and data concerning rare earths and since we in Molybdenum Corporation of America have been developing the us of rare earths in the steel industry, I think that there are some statements there which should be corrected.

In the third column under the heading of "Principal Uses," you mention that attempts to use rare earths in carbon steels did not prove economical. We do not think this is a correct statement with reference to carbon steels because as a matter of fact, there is a large tonnage of steel which is regularly being produced using our rare earth materials, and this has been going on for some time and, to the best of my belief, will continue to expand in the future.

Naturally there is considerable development work going on in a number of grades of steel to determine where it may be used satisfactorily, and in some isolated cases the material has not proven economical, but we do have quite a number of grades of steel in which the reverse is true. We think, in drawing these facts to your attention, that your readers will be able to obtain a true picture of the present status of the use of rare earth materials in steel mill applications.

Norman F. Tisdale
Manager of Sales
Molybdenum Corp. of America
Pittsburgh, Pa.

New Assessment Deadline?

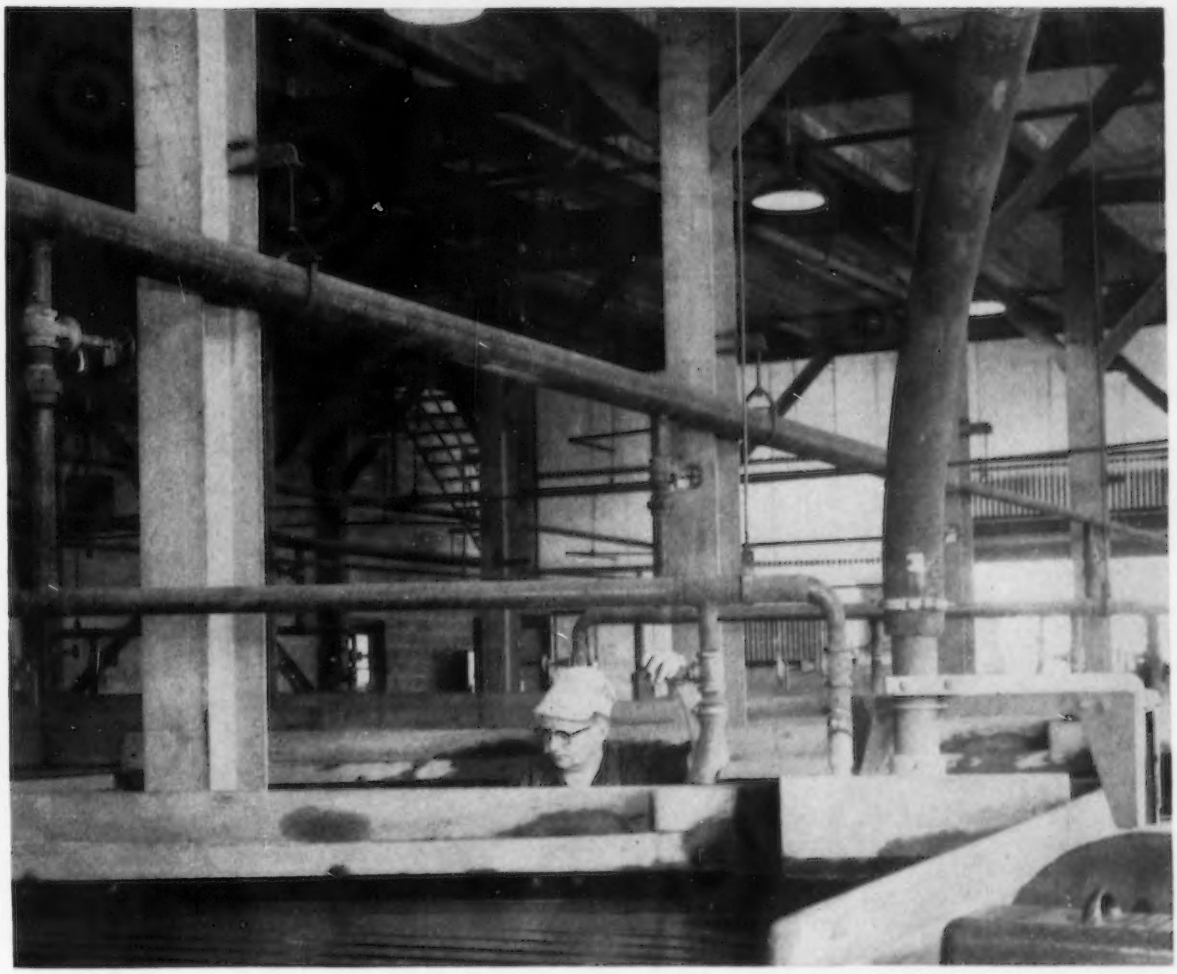
Dear Sirs:

Some time ago I saw an article in the *Salt Lake Tribune*, that the assessment deadline had been changed to a later month in the year. I have been reading your journal and have not run across anything on it. Could you enlighten me on the subject?

W. B. Whetstone
West Yellowstone, Mont.

• A check with the Bureau of Land Management, U. S. Department of the Interior, at presstime revealed that there is at present no extension of the deadline for assessment work, noon, July 1. Bureau points out that there has always been a special act on the books which does not enforce the deadline in exceptional cases where the claim is in litigation, but that otherwise the July 1 date is the final one. In the past when legislation has been "dropped in the hopper" to extend the deadline, the Bureau of Land Management has always filed an adverse report. Should a move be underway to extend it now, it would again be opposed by the Bureau, Washington observers say.—Ed.

B.F.Goodrich



Hose swallows coal that's dug out of a river

A typical example of B. F. Goodrich improvement in rubber

FROM the bottom of a nearby river comes the coal used in an eastern power plant. The coal, along with silt, sand and water, is dredged from the river, and pumped into this building where the coal is separated.

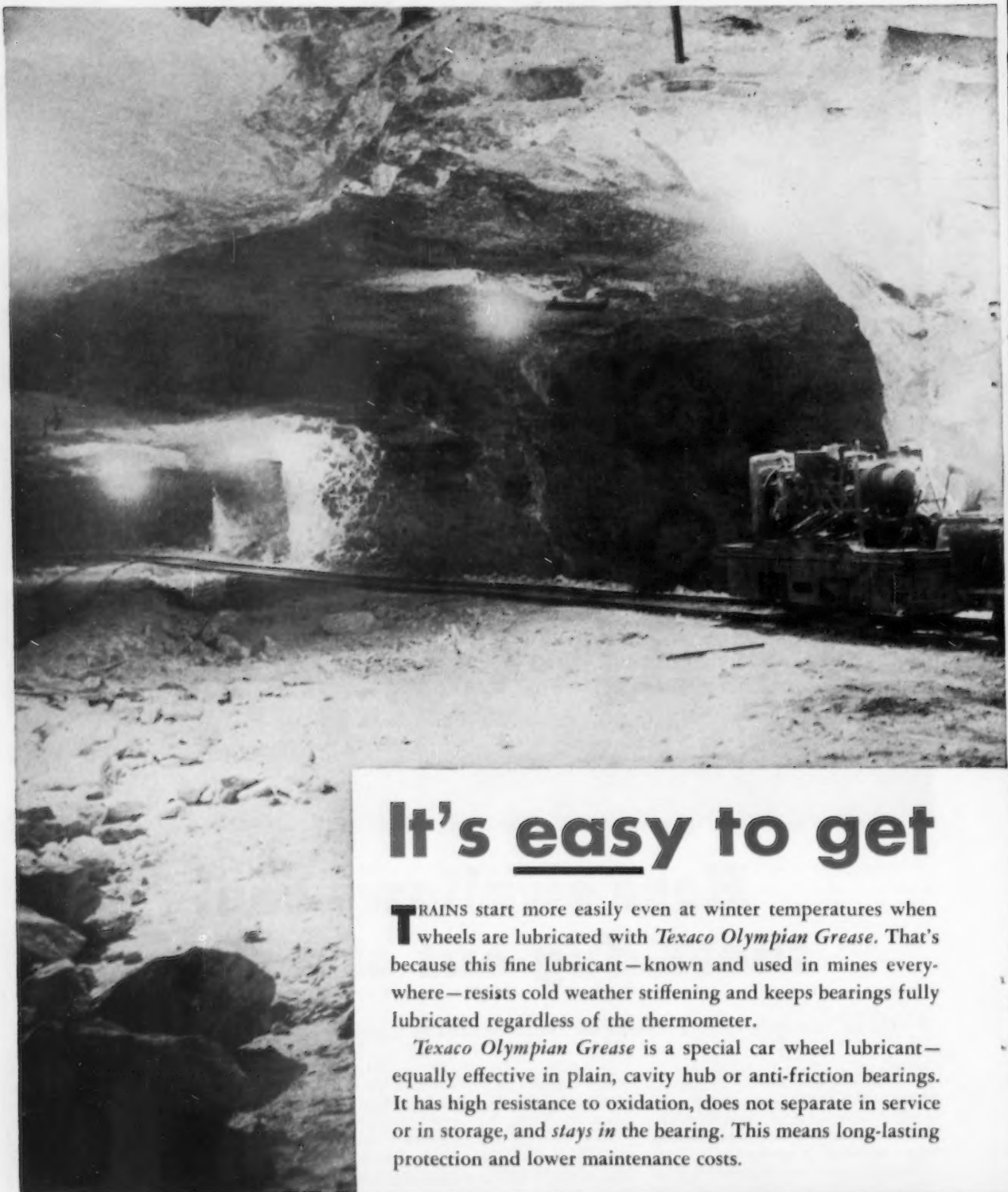
But there was one trouble. A hose connected the pipe to the tanks you see in the picture. And the sharp, gritty particles were wearing right through the hose in only nine months.

Then a B. F. Goodrich man heard about the trouble, and suggested a new B. F. Goodrich hose with a special lining made of the toughest wear-resisting rubber known. Another hose just like this has even swallowed 10-pound chunks of iron ore without damage. So, in this power plant, after 18-hour-a-day use for over a year, the B. F. Goodrich hose is still in such good shape that engineers expect it to last another three years.

B. F. Goodrich has made hundreds of improvements in dozens of kinds of hose to make them last longer, cost less. Most improvements, while making the hose stand more abuse, have also made it more flexible and easier to handle. B. F. Goodrich makes hose to carry almost anything—air, water, gasoline, steam, chemicals, and even dry materials such as flour or cement. Your B. F. Goodrich distributor is an expert at solving hose problems. Call him when you need help, or write *B. F. Goodrich Industrial Products Company, Dept. M-632, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS



It's easy to get

TRAINS start more easily even at winter temperatures when wheels are lubricated with *Texaco Olympian Grease.* That's because this fine lubricant—known and used in mines everywhere—resists cold weather stiffening and keeps bearings fully lubricated regardless of the thermometer.

Texaco Olympian Grease is a special car wheel lubricant—equally effective in plain, cavity hub or anti-friction bearings. It has high resistance to oxidation, does not separate in service or in storage, and *stays in* the bearing. This means long-lasting protection and lower maintenance costs.

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TEXACO STAR THEATER
starring
JIMMY DURANTE
on television . . .
Saturday nights, NBC.

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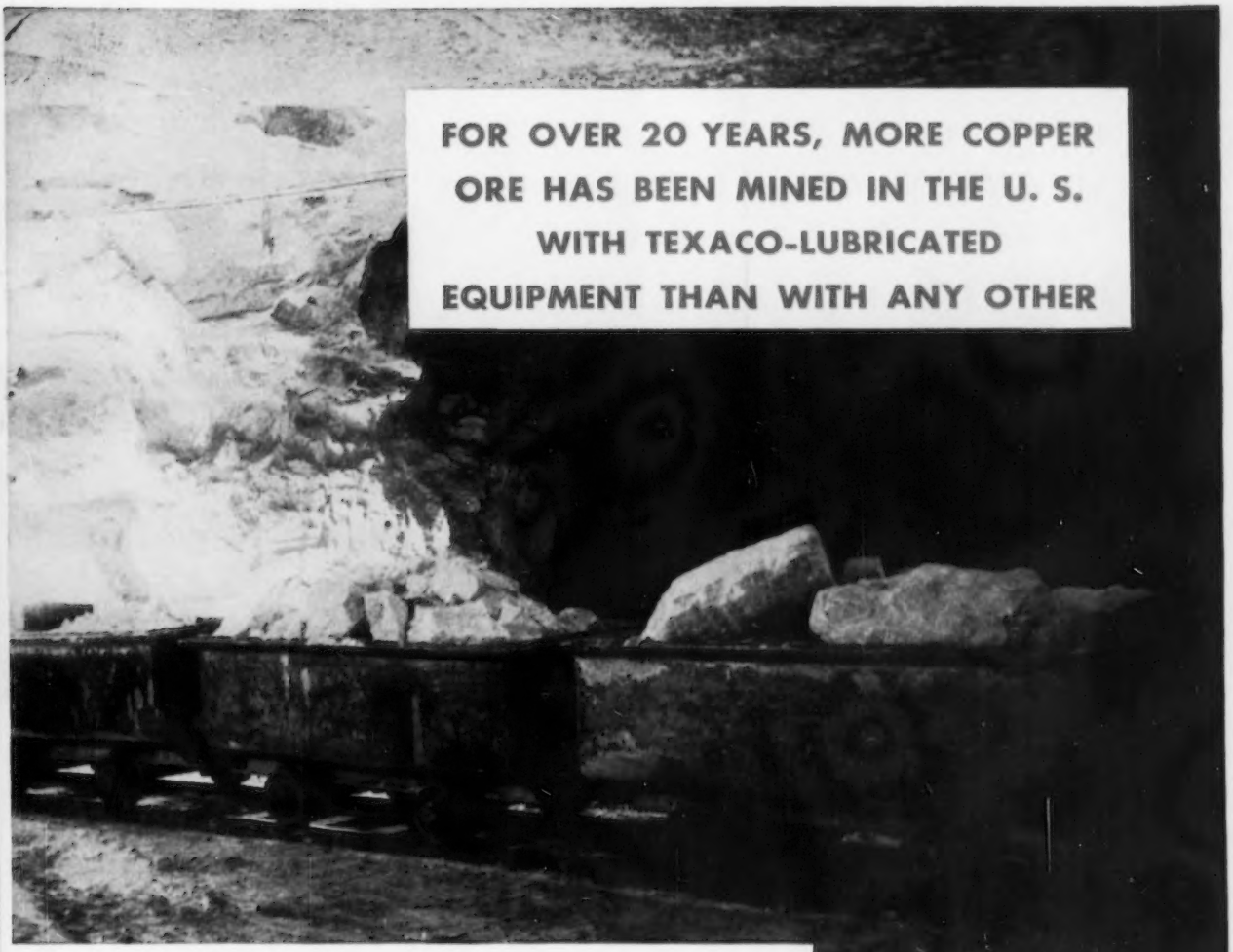
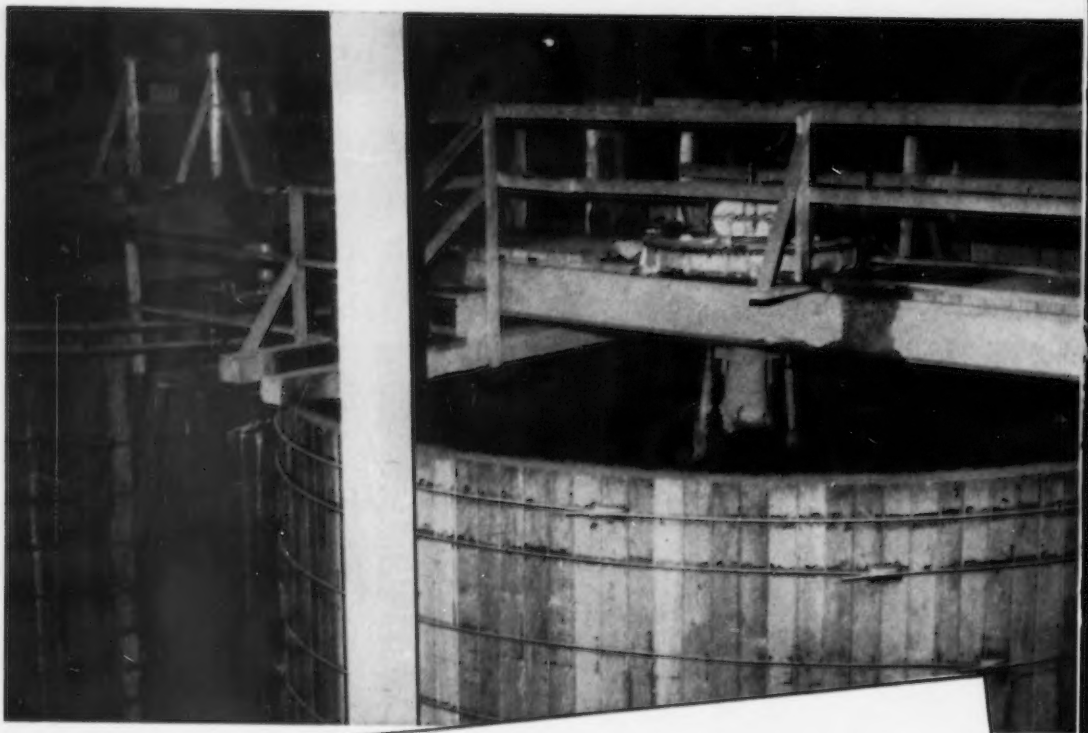


easier starts—

To best lubricate and protect wire rope and open gears, use *Texaco Crater*. It keeps rope strong longer . . . assures smoother operation and longer life for gears. If you prefer the extra convenience of fluid application, use *Texaco Crater X Fluid* for both purposes.

A Texaco Lubrication Engineer will gladly help you select the proper lubricants for all your equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

Lubricants and Fuels
FOR THE MINING INDUSTRY



Two of the twelve Dorr Agitators installed at Gunnar.

URANIUM PRODUCTION AT GUNNAR MINES LTD.

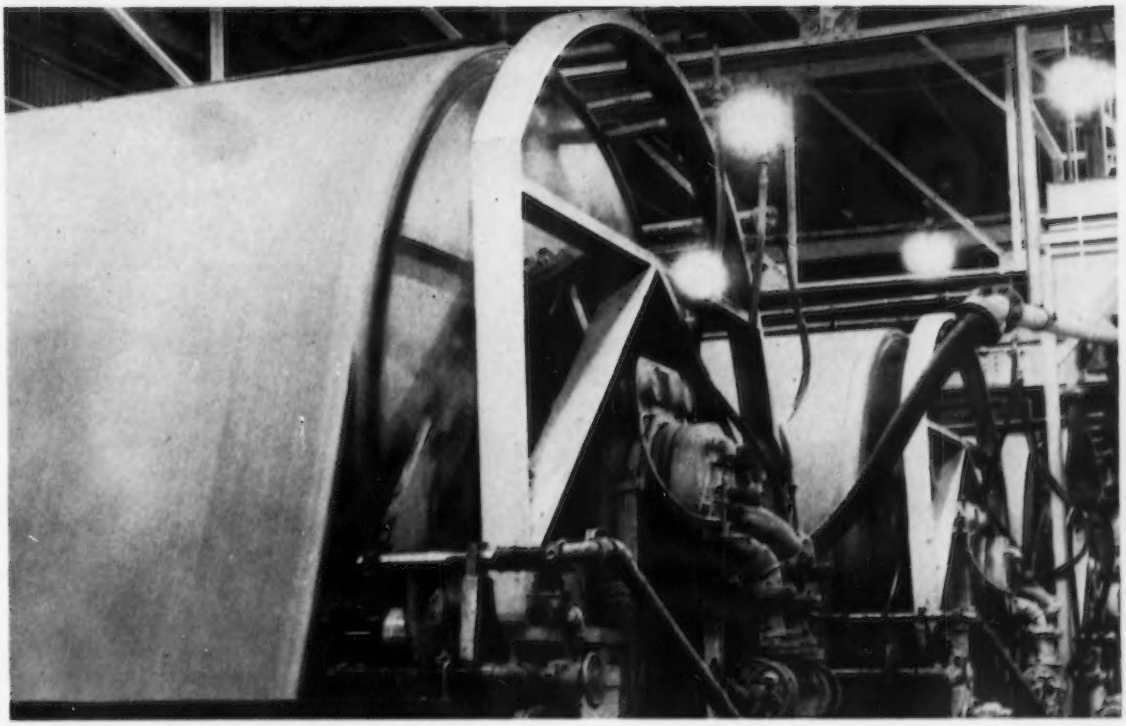
One of the early Uranium producers in North America, Gunnar Mines Limited at Uranium City, Saskatchewan selected Dorr-Oliver-Long equipment for above and below ground operations from our Associate Company in Canada. For the *leaching section* twelve acid resisting Dorr Agitators are installed, each 20′ dia. by 20′ deep. For the *neutral circuits* four 3-compartment Dorr Tray Thickeners are used, each 50′ dia. by 23′ deep and two 8′6″ dia. x 7 Disc American Filters. For *final residue washing*, six Oliver String Discharge Filters are employed, each 11′ 6″ x 16′ face with acid resisting construction. In the *precipitation section* is the first Rubber Lined Sweetland Filter ever built.

Now an open pit operation, Gunnar plans a new shaft in the near future and has ordered from Dorr-Oliver-Long the front dump skip, cage, head sheaves and Granby type mine cars.

For more information on the complete line of D-O equipment for the mining industry, write to Dorr-Oliver, Stamford, Connecticut.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

Closeup of one of the Tray Thickeners showing drive mechanism and feeding arrangement.

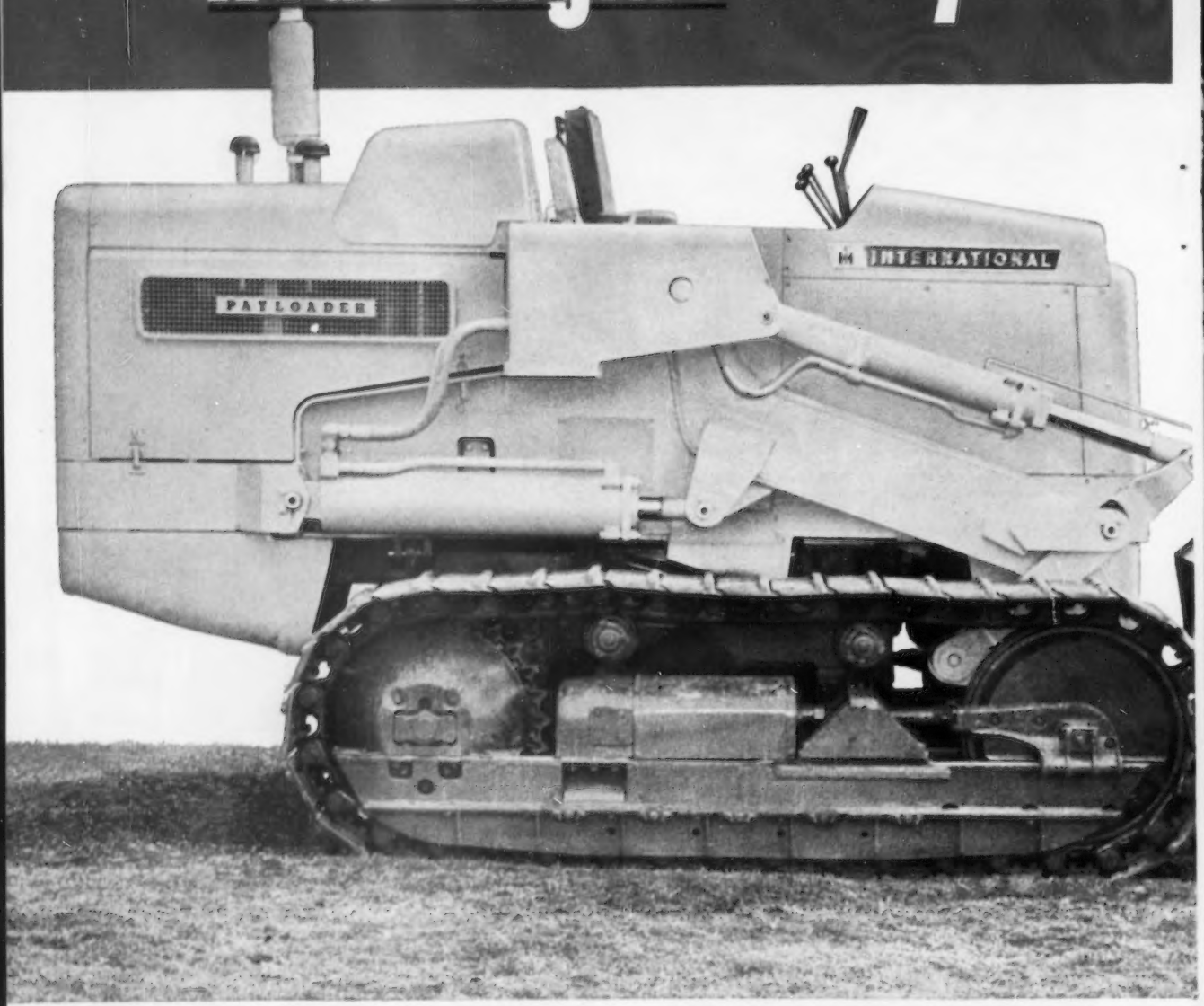


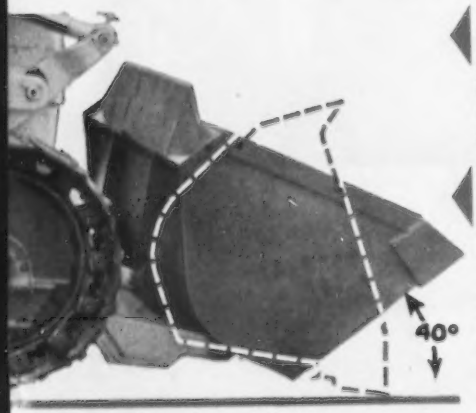
Three of the six Oliver String Discharge Filters. Three additional Filters have since been ordered.

Photographs by J. Wilson, Gunnar Mines Ltd.

AMAZING !... NEW !...

Rear-engine 1¾ yard





PRY-OUT BUCKET ACTION: Tremendous 17,500-lb pry-out force is obtained by using break-out pads on ground as fulcrum for leverage. This transfers load forces to ground instead of to machine.

40° BUCKET TIP-BACK AT GROUND LEVEL permits digging of bigger bucket loads, *plus* retaining of more of load in bucket during lifting and carrying.

OPERATOR SITS COMFORTABLY in foam-rubber seat, handles conveniently-placed, power-boosted controls, can see load and cutting edge at all times.

International® Payloader®

- **New—this highly-maneuverable crawler tractor-loader with "power-shift" transmission teamed with Torque-Converter advantages—to give you maximum possible material-moving capacity and speed in any given condition.**
- **Operator sits up front, close to bucket, can always see what he's loading, where he's going.**
- **Speed unmatched in crawler history, 10 mph forward, 13 mph reverse, provides faster cycles.**

If it's *speed* and *maneuverability* and *big capacity* you want in a crawler-loader, see the new International 1¾ yard Model 12 Payloader!

This amazing new 91½ hp loader seats its operator *in front of the engine*, up close to the bucket, where he has an unobstructed view of everything from cutting edge to toe of bank. It balances the tractor between rear-mounted engine and front-mounted bucket. Weight is evenly distributed over entire length of tracks. You get better traction, longer track life, better stability on grades, less bogging down in spongy ground.

Your operator moves faster on this new Payloader, too. He can go up to 10 mph forward, 13 mph in reverse. He changes speeds or direction instantly through a full-power shift, three-speed transmission. No waiting, no stopping, ever! *All* shifts through *all* speeds can be made in either forward or reverse under full engine speed WITHOUT SLOWING DOWN. Torque-converter gives you maximum digging-power for the toughest jobs. (Operation gets *another* boost from the torque converter . . . it provides an infinite range of speeds, automatically selecting the one which best balances load and torque.) Steering is a finger-tip cinch, too, because each *steering clutch* and *brake* is controlled by one power-boosted lever *only* (no foot steering brakes).

Try this new International Model 12 Payloader for yourself. Your International Industrial Power Distributor will be glad to demonstrate. Call him soon! A good deal awaits you!

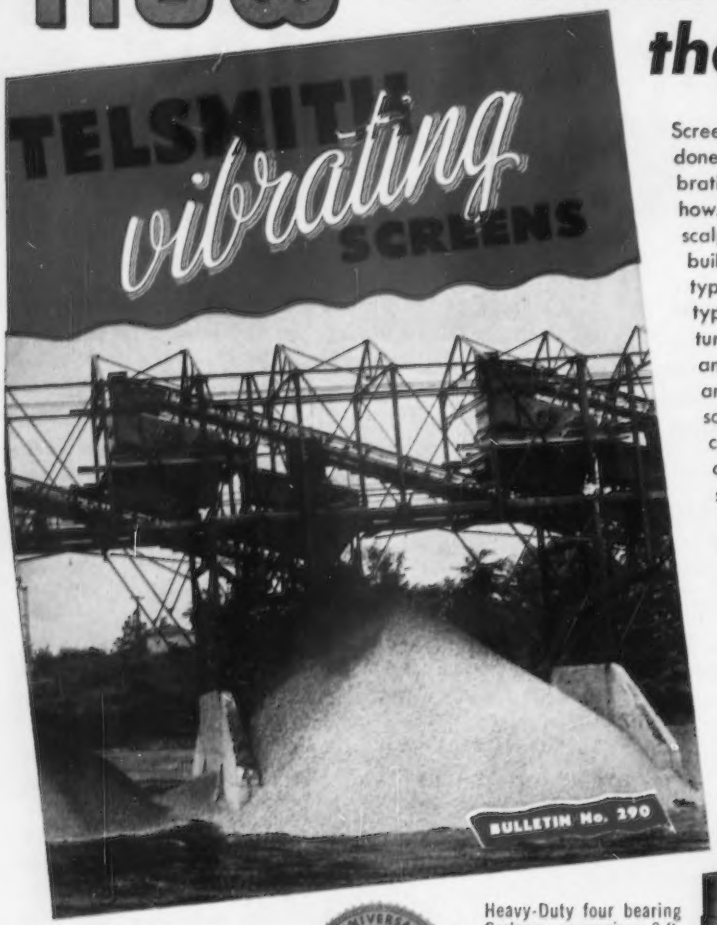
INTERNATIONAL HARVESTER

International Industrial Power

180 N. MICHIGAN AVENUE—CHICAGO 80, ILLINOIS

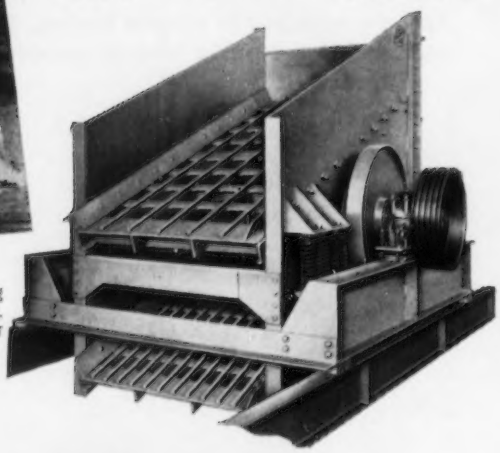
A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Tractor and Rubber-Tired Loaders . . . Diesel and Carbureted Engines

HOW TO PICK SCREENS *that pay profits*



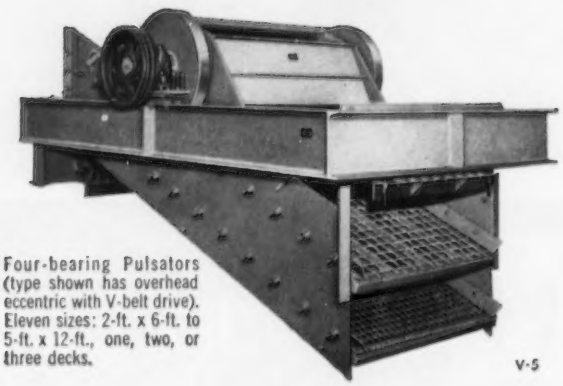
Screening aggregates is a tough job—but it can be done efficiently and at low cost—with Telsmith Vibrating Screens. This new Telsmith bulletin tells you how. It explains which type of screen is best for scalping . . . sizing . . . washing—and why Telsmith builds two types of four bearing screens and one type of two bearing screen. It describes each type; shows several new Telsmith Vibro-King features, including—new counterweight mechanism and new spring suspension, making it the smoothest and most efficient screen you can buy, either for scalping or finishing. Shows new heavy-duty tray construction; best methods for mounting screen cloth. Full of helpful pictures, diagrams and specifications.

Get this NEW BOOK FREE—Ask for No. 290



Heavy-Duty four bearing Scalpers—seven sizes: 3-ft. x 6-ft. to 5-ft. x 14-ft., one or two decks.

Two-bearing Vibro-King Screens—eleven sizes: 3-ft. x 6-ft. to 5-ft. x 16-ft., one, two, or three decks.



Four-bearing Pulsators (type shown has overhead eccentric with V-belt drive). Eleven sizes: 2-ft. x 6-ft. to 5-ft. x 12-ft., one, two, or three decks.

V-5

SMITH ENGINEERING WORKS

502 E. CAPITOL DRIVE **MILWAUKEE 1, WISCONSIN**

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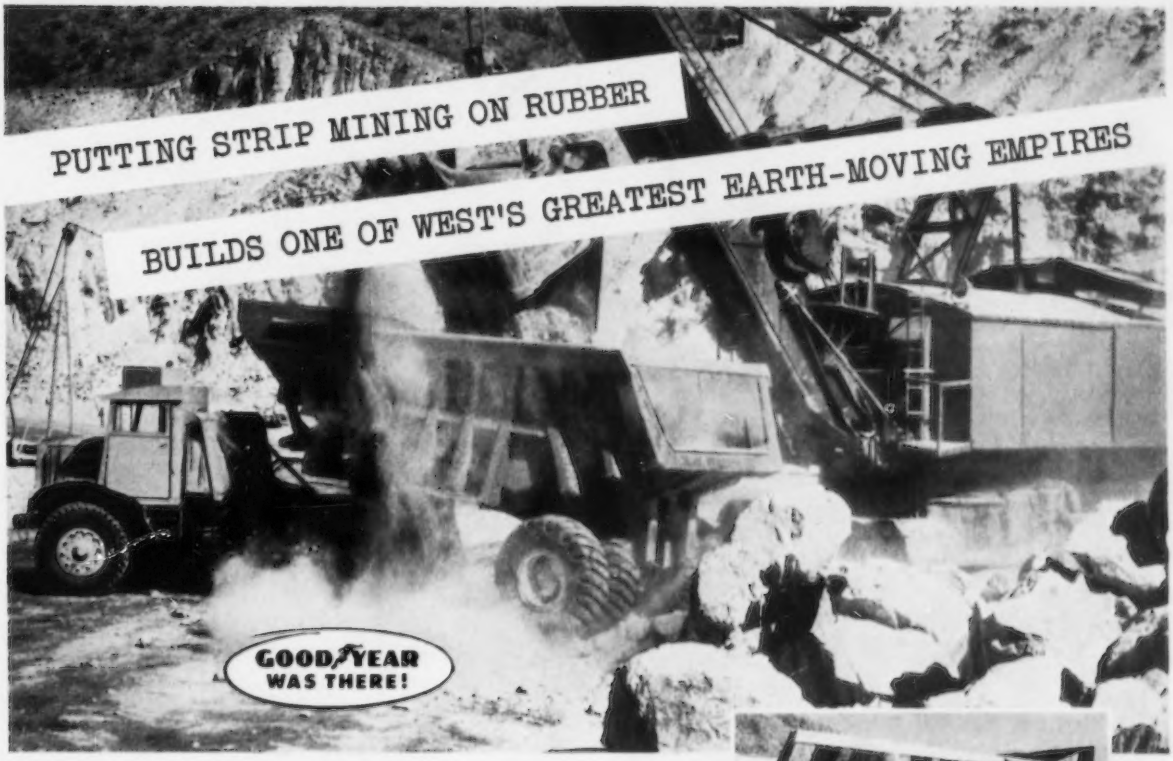


When the Isbell Construction Company was still a fledgling earth-moving outfit, strip mining was done on rails. By proving the greater speed and economy of rubber-tired equipment, Isbell became one of the country's leading mine strippers. In the last ten years, Isbell has moved over a quarter-BILLION tons of ore and waste—has built more than 1,000 miles of roads—now owns a multimillion-dollar array of mining and road-building equipment—and is still rolling ahead in operations from Canada to Mexico! Tires in this picture are Goodyear's famous Hard Rock Lug.

TRUCKS AND TIRES ARE WASHED DOWN DAILY—parts, treads and sidewalls are carefully inspected. Expert tire care pays off big.

NOW IN 3-T NYLON CORD—CONVENTIONAL OR *TUBELESS!*

There is a Goodyear dealer near you. See him for better tire values—better tire care.

Another great Goodyear FIRST ends tube and flap troubles FOREVER!

Now—no matter how big your equipment—you can buy and specify Goodyear off-road and earth-moving tires in TUBELESS!

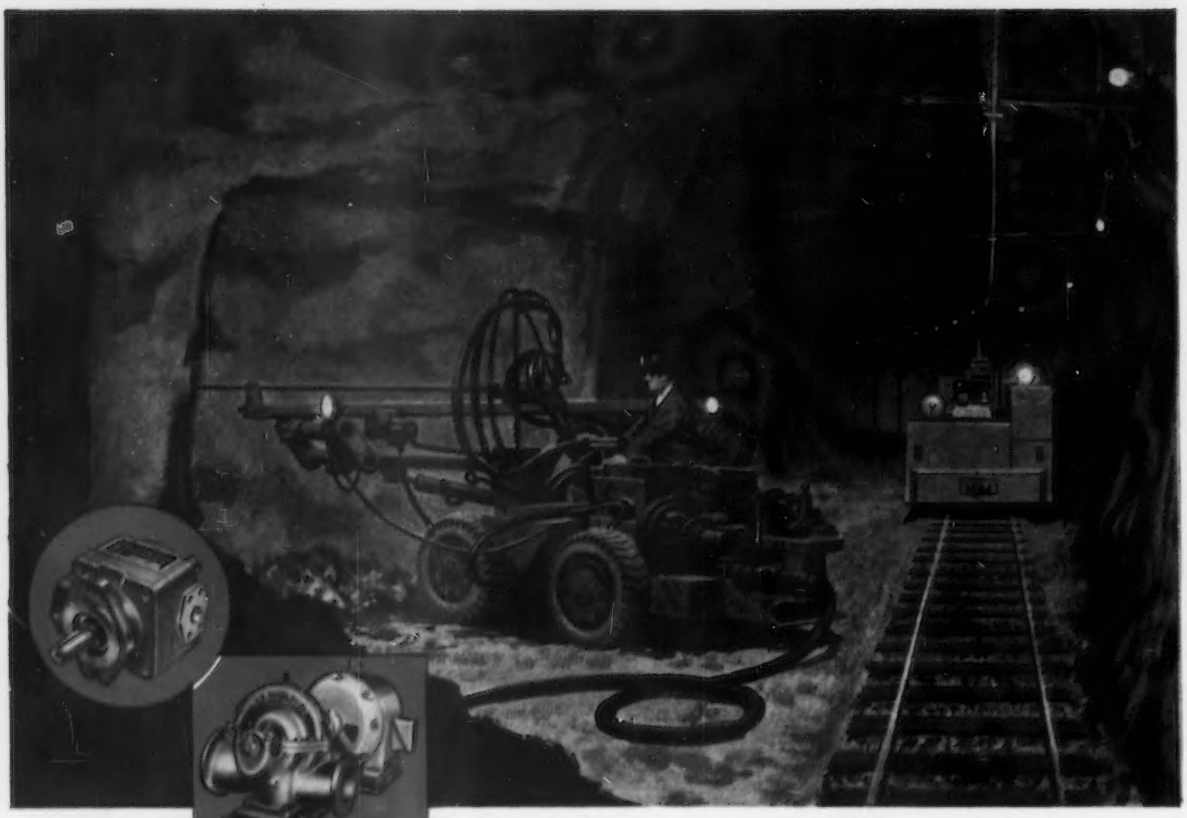
They're practical—they're proved—they're cost-cutters—the tire, rim and trucking industries have adopted Goodyear's "Smallest-to-Largest" program—leading equipment manufacturers have adopted Goodyear tubeless tires and rims as standard or will supply them as specified—*and you can switch RIGHT NOW, quickly and economically!*

Your potential savings can obsolete all previous ton-cost figures. Get the glad facts direct—from your Goodyear dealer. Goodyear, Truck Tire Dept., Akron 16, Ohio.

Buy and Specify **GOODYEAR**

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

Road Lug, All-Weather, Sure-Grip—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



DUDCO Dual-Vane Hydraulic Pump

AURORA Horizontal Split-Case Centrifugal Pump

Find It . . . Get to It . . . Dig It Out . . . Save Time With Power

FLUID POWER

Mining, from strike to full operation, measures profits in time, because time saved can be as important in the profit picture as the grade of ore.

Consider the products made by Divisions of The New York Air Brake Company as the means for saving time, raising efficiency and lowering costs. DUDCO Dual-Vane Pumps and Motors . . . HYDRECO Gear Pumps and Motors, Valves and Cylinders provide the Hydraulic equipment for drilling, cutting, collecting, loading and transfer of ore as well as for Hydraulic Power on conveyors, grinders and shakers at the mill.

The AURORA PUMP and KINNEY MFG. DIVISIONS produce the "right" pump for every Liquid Handling requirement . . . Turbine-type Pumps for water supply . . . Centrifugal Pumps for handling drainage and liquids containing solids . . . Gear and Rotating Plunger Pumps for sludges, slurries and heavy flotation liquids.

KINNEY High Vacuum Pumps bring another vital tool to the refinery. Developing pressures to 0.0001 mm Hg., vacuum processing opens up entirely new vistas to the metallurgist . . . and new economies in refining and the reclaiming of many metals.

More and more, engineers reach for improved techniques by employing the versatility, dependability, time and money-saving performance that distinguish Fluid Power.

Engineers of The New York Air Brake Company are a well-spring of "know-how" on Fluid Power. Get to know more about N.Y.A.B. products and the many new developments in Power Hydraulics, Liquid Handling and High Vacuum Equipment.

Write today for literature on AURORA, KINNEY, DUDCO, HYDRECO and STRATOPOWER products.

KALAMAZOO DIVISION
Kalamazoo, Mich.
HYDRECO Gear-Type Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 3 to 52 hp; Cylinders; Control and Auxiliary Valves; 1500 psi. DUDCO Dual-Vane Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 7 to 140 hp; 2000 psi operation.

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Railroad air brake equipment of all types, STRATOPOWER Hydraulic Pumps for Aircraft, to 3000 psi.

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Liquid Handling Pumps, Centrifugals and deep well Turbines, 7000 gpm, 500 ft. heads. Turbine-type, 150 gpm, 600 ft. heads. Condensate Return Units.

KINNEY MANUFACTURING DIVISION
Boston, Mass.
Rotating Plunger and Heliquad Liquid Handling Pumps, to 3000 gpm. Vacuum Pumps, 0.2 micron, evacuate 1800 cfm.

THE NEW YORK AIR BRAKE COMPANY

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INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N. Y.

WHAT IS YOUR ORE HANDLING PROBLEM?

HERE, on this page, we can show you only the barest indication of the wide range of mining operations in which Northwests are serving. Northwests are handling iron in New York and on the Range. They are handling lead and copper at Copper Mountain, B.C. (over a million tons a year and only 3 hours down time). Uranium, gold, phosphate, bauxite, zinc — what are you interested in? There are Northwests in practically every kind of mining that you could ask about.

The point is that Northwest advantages often make possible speed that outproduces larger machines. Northwest features for handling harder digging, the Northwest Dual Independent Crowd that utilizes force most independent crowd shovels waste, combined with Northwest's rugged construction make it a *real hard rock* machine.

Compact design, along with positive traction on both crawlers while turning as well as when going straight ahead take it onto narrow benches safely and around the mill where larger rigs couldn't go.

And these are just a small part of the advantages Northwest machines have for every mine. Plan now to have a Northwest. A Northwest man or a Northwest sales agent will be glad to tell you more.

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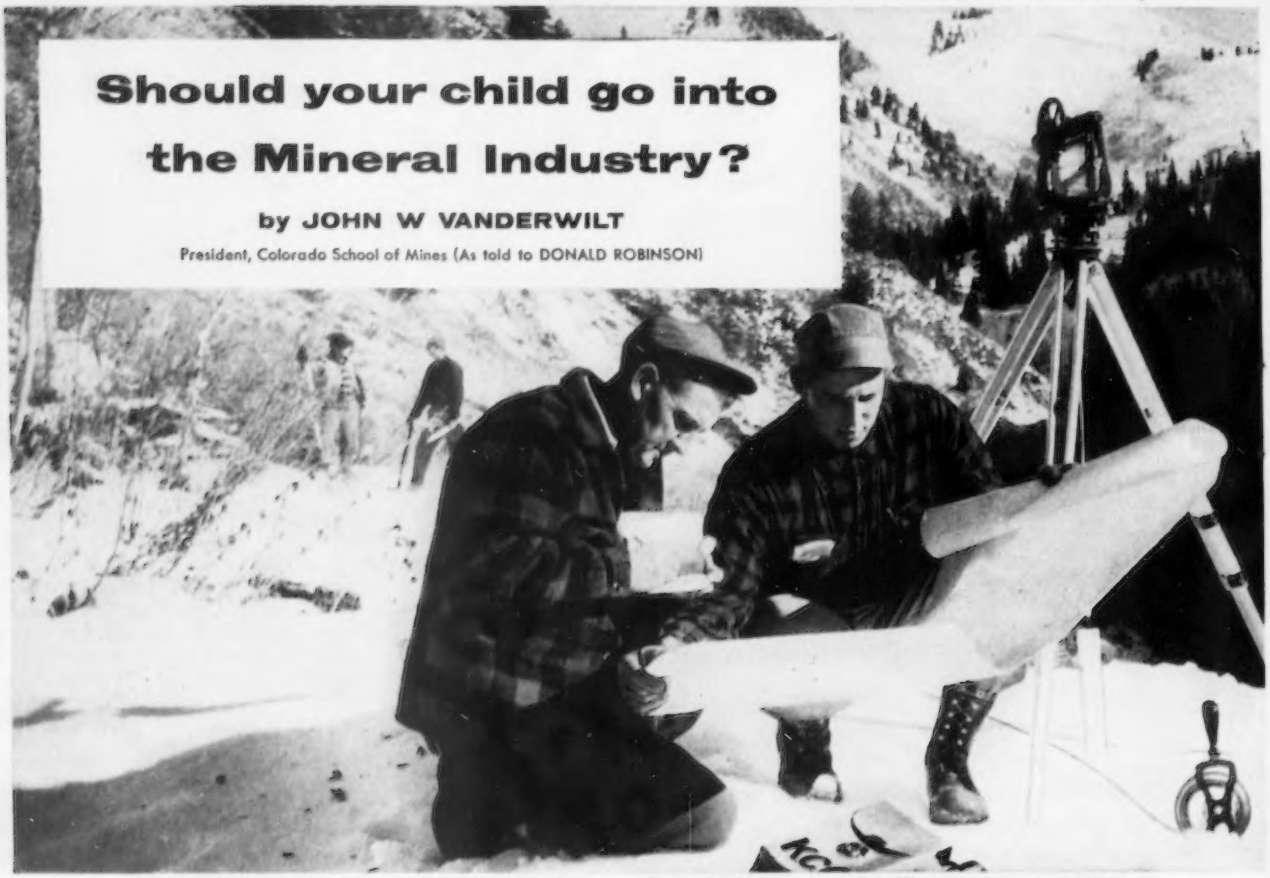
G-410

Should your child go into the Mineral Industry?

by JOHN W VANDERWILT

President, Colorado School of Mines (As told to DONALD ROBINSON)



Prospecting is one area of the mineral industry which holds great fascination for many young men. The search for nature's hidden resources often brings a geologist or geophysical engineer unusual opportunity for travel, adventure and rugged outdoor living.

I'VE HEARD it said that the day of the pioneer is gone. That we Americans have turned soft. That, somewhere down the line, we've lost our old-time taste for exploration and adventure.

"There just aren't any more Davy Crocketts or Dan'l Boones left," people tell me. It isn't so, though.

At this very moment, Americans are making their way into some of the wildest, most remote corners of the world, with the same disregard for danger and discomfort that our pioneer-ancestors showed.

I know of Americans who are daring the backwaters of the Amazon; others who are scaling the Andes, cutting through the jungles of Africa, crossing the barren deserts of Asia, battling the snake-infested swamps of our own southland. And, without fear of contradiction, I can say they're relishing every minute of it.

"Never had it so bad, and never enjoyed anything so much," one of them wrote home.

These young men—as well as their colleagues in more settled mines, mills and laboratories—are trail blazing along a never-ending frontier: the mineral industry. Regardless of difficulties, they are finding precious minerals, extracting them and then converting them into their most useful, valuable forms.

It is a vital job they are all doing.

Our national economy is rooted, in large part, in mineral production. Take coal. Without it, much of America's industry would grind to an immediate halt. Without oil, no plane would fly, no automobile would run. Without copper, every electric generating station would shut down. Without uranium, our national defenses would be crippled. And the same thing is true for dozens of other minerals.

Recently a friend of mine remarked to me, "Our entire civilization would crumble if it weren't for minerals and the scientists and engineers who make them available to us." He was not exaggerating the situation one whit.

There are several different categories of scientists and engineers in the industry. In brief, this is what they do.

The geologist deals with the structure of the earth. In particular, he specializes in the properties, occurrence and uses of minerals and rocks.

The geological engineer covers much the same area, but he pays more attention to the practical applications of the science and less to basic research.

Next is the geophysical engineer. He seeks hidden indications of mineral wealth by means of seismic, magnetic and other new, almost magical methods.

The mining engineer is responsible for taking the raw materials from the earth.

Now comes the metallurgical engineer and he has a vast scope, too. He not only works on the extraction of metals from their ores, but on the adaptation of these metals to man's purposes. He is constantly evolving new and better alloys or new uses for old alloys.

The petroleum engineer concentrates on obtaining oil and gas out of the earth.

The petroleum refining engineer takes up where the petroleum engineer leaves off. His job is to develop and improve the many thousands of products, such as gasoline, lubricants and asphalt, that can be made out of petroleum; or that utilize petroleum, such as nylon.

Last is the ceramic engineer. He focuses on nonmetallic minerals and the products that can be fabricated from them, such as brick, glass, enamels, electric insulators and high temperature products.

The industry in which all these professions are engaged is enormous. In the U. S. alone, the value of mineral production was, at last count, over $13,000,000,000 a year. Today, more than one tenth of all gainfully employed Americans make their living out of minerals.

For scientists and engineers, the horizons of this industry are especially wide. They can be based here or abroad. They can go out in the field and prospect for new mineral deposits or they can work in already proven mines. They can accept posts in manufacturing plants, research laboratories and government offices. Or, if they prefer, in college classrooms.

Openings for trained men are many. I say this from personal observation.

"Did you have a tough time finding a job?" I asked one of our graduates recently.

"Gosh, no," he replied. "The toughest problem I had was choosing which job I liked best."

The fact is that there is a decided scarcity of young scientists and engineers in minerals. Throughout the entire United States, the total number of graduates in this field, last year, was under 1,500. Most students at top-flight schools are offered between three and four jobs each, upon graduation.

Naturally, you want to know what the financial outlook is for mineral men. Here is the picture.

Graduate engineers can expect a starting salary in industry of $365 to $425 a month. Inside of five years, those with average ability should be drawing $7,500 a year. Ten years after graduation their earnings should be $10,000. Only the sky is the limit for very good men. Many engineers go into top management and earn exceptionally high pay. I know several who are making $50,000 to $100,000 a year.

Teachers usually begin with about $3,600 a year and top men go up to $10,000 a year. Moreover, a school year is usually nine months and some faculty men regularly double their year's income by acting as industrial consultants during their vacations.

Always, for anybody in the mineral industry who tries, there is the possibility of striking it truly rich. A few years ago, a penniless young geologist I know went prospecting for uranium. He spotted a deposit. A big one. Today it is reported that he is worth several million dollars.

This past year two of our own students at the Colorado School of Mines went prospecting for uranium in their spare time after class. They made a sizable strike within twenty-five miles of the campus.

There are also rewards in minerals beyond money. It is an exciting, adventure-filled life. The work presents a ceaseless challenge. Best of all, you feel that you are helping to create new wealth, new industries, new jobs for your fellow men.

I know that sensation at firsthand. Back in 1928, I was associated with a group of U. S. Geological Survey men sent to prospect for potash deposits. The United States was then dependent upon foreign producers for most of its potash for fertilizer and other industrial uses.

We began drilling east of Carlsbad, New Mexico. Down we went 500 feet. All we found was rock of no value. Down we went to 1,000 feet. Still only worthless rock. Deeper we drilled to 1,500, 1,800, 2,000 feet below the surface of the earth.

Up came more samples of ore. This time the samples were spotted with sylvite and bitter-tasting potash chloride. We'd hit a fine deposit.

In large part, the American potash industry—producing about two million tons a year—has grown out of that one strike. It is a source of genuine satisfaction to me.

Rewarding as the mineral industry is, you musn't think that it is all "peaches and cream." The hours are long and the conditions can be rugged. Young mineral men may find themselves working in a dilapidated lean-to deep in the Canadian bush, or on an exposed drilling platform away out in the Gulf of Mexico, or in a cramped Quonset hut off on the burning sands of the Arabian Peninsula. Even in this country, they may have to make their home in a pup tent on some jagged wasteland 100 miles from civilization. For months on end they will have no medical facilities, no recreational outlets, no comforts of any sort. Long separations from wives and families can be the rule, not the exception.

Certainly, I would not recommend the mineral industry for a girl unless she were prepared to overcome herculean obstacles. Some women have done well in geology, and a few at the research side of mineralogy, but they are still the exceptions.

Is there any way, people sometimes ask me, to tell whether a boy is well-suited for a career as a scientist or engineer in the mineral industry?

I think there is. Answer these questions honestly and you should have a fair idea of a boy's prospects.

1. Is the boy curious about scientific matters? Does he wonder about the make-up of the earth, for instance, or the broad principles underlying atomic energy? He should. 2. Is he good at mathematics, chemistry and physics? He'll need to know them through and through. 3. Is he adept with his hands? 4. Has he an analytical, broad-visioned mind? This is a field that requires clear and creative thinking. 5. Can he make up his mind quickly? He'll have to. Men's lives may depend on it.

Just recently, a young mining engineer was walking through a passageway down in a coal mine when his nose picked up a trace of gas. He didn't stop to talk. Instantly, he ordered the mine cleared. If he hadn't, eighty-odd men would have probably been fatally gassed.

6. Is the boy in good health and does he have a robust constitution? Both are vital. 7. Does he have a sense of adventure and does he enjoy outdoor life? If he doesn't, he's going to be a fish out of water. 8. Does he get along well with people? In this industry, he has to be a team player.

Now we reach the question of how a boy obtains his training for the mineral industry. It's not easy. I must tell you that.

High grades—a boy should be at least in the upper half, preferably the upper third of his high school class—are essential for entrance to a good college. And, an extensive grounding in mathematics, chemistry and physics is imperative.

What college should a boy go to?

The boy thinking of geology solely as a pure (rather than as an applied) science can go to practically any college with a well-rounded scientific course. Not so the boys interested primarily in the engineering aspects of the mineral industry. They should enter a college offering specific engineering courses in mining, metallurgy, petroleum and the related professions.

The courses vary in length. Some of them run four years, others five. All of them are difficult. At least, they require serious and persistent work. Which is as it should be. Only a fully-prepared man can get ahead in the mineral industry today.

Is it expensive to secure an education?

It's not cheap. Tuition, books, board and other campus expenses should cost the average boy between $1,000 and $1,500 a year. However, this doesn't mean that a boy without that much money is barred. If he wishes, he can try for a scholarship. Most colleges give many. So do a number of industrial companies. And he can work his way through school. I did. I wish I had a dollar now for every furnace I stoked while I was at college.

Of one thing I'm sure. It's worth a struggle to get into this field. For the boy with ability and interest, who is willing to work, the future is unlimited.

nylic

HOW TO HELP YOUR CHILD HAVE THE CAREER HE WANTS

Many factors will enter into your child's choice of a career: his interests, his ambitions, his abilities, the counsel he receives from teachers, friends and family. But, most of all, it will depend on his opportunities *to get the training he needs to enter the field of his choice.*

Even though his college days are still years away, it's never too soon to start making sure that your child will have the opportunity to continue his education when the time comes.

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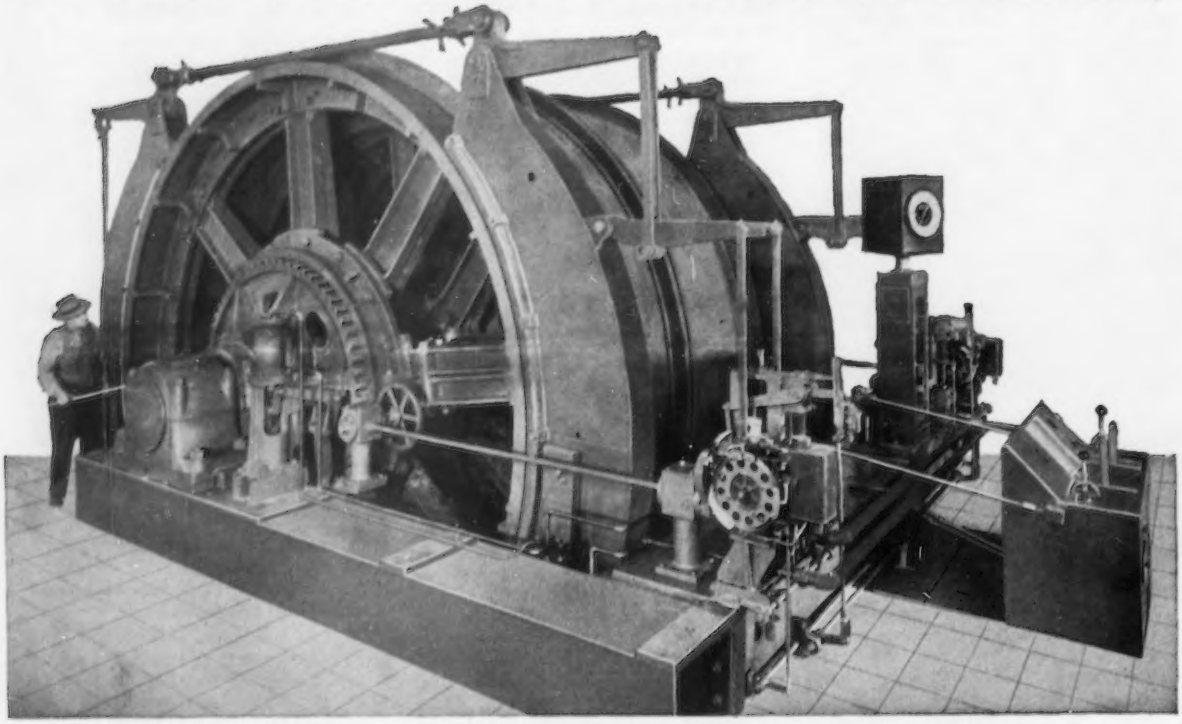
ELECTRIC MINE HOISTS FROM VULCAN OF WILKES-BARRE



ARE DESIGNED AND BUILT TO MEET ANY SPECIFIED REQUIREMENTS

The Electric hoist shown above has "everything" to promote fast, safe, economical operation. Weighing approximately 420,000 lbs. it will be driven by two 1250 hp. A.C. motors through single-reduction herringbone gears which are completely enclosed in an oil-tight steel casing.

The two "Built-Up" all-steel drums, 18 ft. in diameter and 4 ft. 3 in. in width, will each carry approximately 2500 ft. of 1¾ in. rope in two layers. One drum is equipped with a positive toothed-type clutch, for balanced hoisting from any one of three levels in a shaft 2625 feet deep. Each drum is equipped with powerful post-type parallel-motion brakes operated by oil-hydraulic brake engines and controlled by modern safety devices which provide dependable protection against any damage that might otherwise be caused by current failure or by errors on the part of the operator. Brake and clutch on the loose drum are mechanically and electrically interlocked.

The main shaft and both of the two pinion shafts are mounted on self-aligning spherical roller bearings. Other modern features include gear-driven micrometer depth indicators, a trip recorder, a recording tachometer and centralized control at a steel desk.

All VULCAN hoists are engineered carefully and built accurately. If you are planning a new hoist, we shall be pleased to send, upon request, our Questionnaire (Form 54) which may help you in the preparation of your hoist inquiry or requisition. There is no charge nor obligation for this service, and the Questionnaire may be of value by insuring consideration of all hoisting factors.

Any information on items listed below will be sent to you immediately:

- Rotary Kilns, Coolers and Dryers
- Rotary Retorts, Calciners, Etc.
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- Automatic Quick-Lime Hydrators
- Briquetting Equipment
- Open-Hearth Steel Castings
- Heavy Duty Electric Hoists
- Self-Contained Electric Hoists
- Cast-Steel Sheaves and Gears
- Diesel Locomotives
- Electric Locomotives and Larrys
- Steel Plate Fabrications
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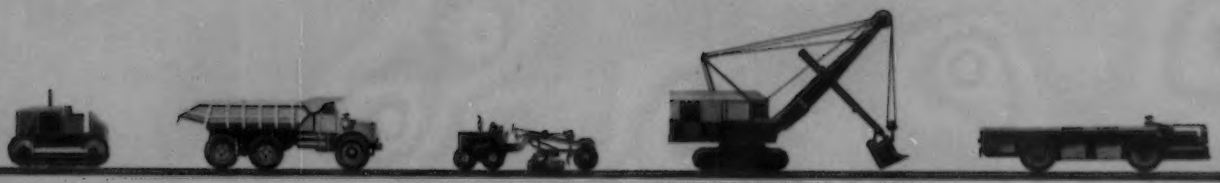

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diesels deliver

New HRT-6 Cummins Turbodiesel *delivers 300 horsepower. This is one of five new Turbodiesels by Cummins. The others: 175 h.p. (model JT-6); 250 h.p. (model NT-6); 262 h.p. (model NTO-6) and 600 h.p. (model VT-12). Turbocharging harnesses exhaust gas energy normally wasted, results in higher horsepower output without increasing engine size or displacement.*

features you need.... profits you want

1	**Exclusive PT fuel system** now standard on all Cummins Diesels. Easier to understand, simpler to service than any gasoline system or any other diesel fuel system.	Drastically reduces fuel system maintenance costs. Eliminates fuel racks, check valves, injection valves, timing adjustments.
2	**Cummins exclusive injectors,** open-type combustion chambers, and 4-cycle operation give highest on-the-job efficiency . . . and maintain it throughout operating range.	With Cummins Diesels, you can cut fuel costs from $200 to $500 or even more for every thousand hours of operation (compared with other diesel engines).
3	**Continuing research,** exacting engineering standards, and strict quality control assure product uniformity and high-quality, rugged heavy-duty design.	You get more operating hours between overhauls, less in-between maintenance and less unscheduled downtime when you use Cummins Diesels.
4	**Twenty-four** basic Cummins Diesels of 60 to 600 h.p. provide a wide selection of power. There are over 150 models—plus a wide variety of accessories—to match every individual job.	By matching power to your job you avoid the possibility of excessive maintenance and fuel costs resulting from under-powering . . . excessive initial costs inherent in over-powering.
5	**Standardization** of internal parts. Bearings, pistons, crankshafts and other parts are interchangeable for many models.	Reduced inventories and greater parts economy are made possible by this standardization. You get lower over-all maintenance costs.
6	**Worldwide** service and parts supply. Cummins Distributors carry all parts necessary to keep your engine running in top form . . . have factory-trained experts available to give immediate service.	Service and parts are available in nearly 200 locations in the United States and Canada and in over 100 export locations—help cut on-the-job delays.

Cummins Diesels are available in the leading makes of mining machinery. On the following pages are shown the makes of equipment in which you can obtain the advantages of Cummins Diesel power.

Before you place an order for new equipment, make sure you're getting lowest fuel and maintenance costs, minimum downtime, longest life. Specify Cummins and be sure you get all these diesel advantages.

CUMMINS DIESELS

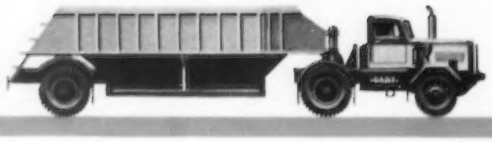
give you the big plus

MORE PROFIT

CUMMINS

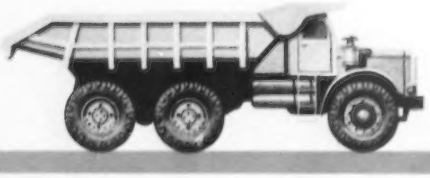
diesels now available

AUTOCAR end-dump truck with 10¼ yard rock body. One of many Autocars with Cummins as standard power.

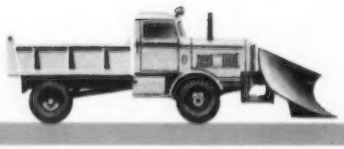


DART 50-ton coal hauler powered by 300 h.p. Cummins. Cummins Diesels are standard power in these coal haulers.

DART 18-ton underground shuttle truck. Available powered by 300 h.p. Cummins Diesel torque converter unit.



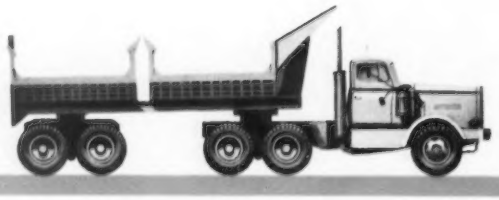
EUCLID 50-ton end-dump truck. One of many Euclid dumps and coal haulers that can be powered by Cummins.



FOUR WHEEL DRIVE quarry and mine maintenance truck. One of two FWD's available with Cummins.

HAYES, model HD series dump truck. This Canadian-built truck is powered by 165 horsepower Cummins Diesel.

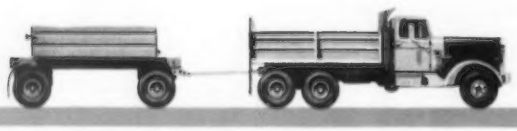
HENDRICKSON 40-ton dump truck. One of twelve Hendricksons available with Cummins Diesels.



IH 35-ton quarry truck with twin side-dump. There are 17 other IH trucks you can buy equipped with Cummins.

KENWORTH 24-ton end-dump truck. One of many Kenworth models in which Cummins Diesels are standard.

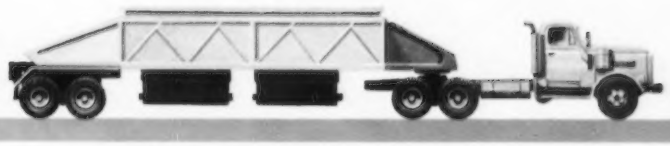
MACK 34-ton end-dump truck. One of fifteen different Mack models available with power by Cummins.



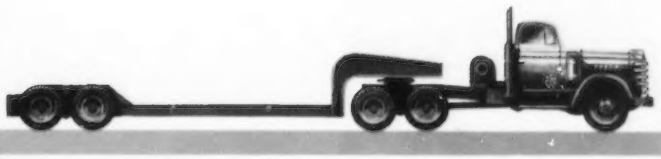
PETERBILT end-dump truck with side-dump trailer. One of 6 Peterbilt trucks in which Cummins power is standard.

WALTER, model ACBS Snow Fighter equipped with a 200 horsepower Cummins Diesel.

in these famous-make TRUCKS



COOK 30-ton bottom-dump truck. Cummins Diesels also available in end-dump and ready-mix units.



DIAMOND T 921 series tractor with low-boy trailer. Ten Diamond T models available with Cummins Diesel engines.

OSHKOSH 35-ton hauling truck with side dump trailer. One of eleven Oshkosh models available with Cummins Diesels.

PACIFIC 11-yard end-dump truck. One of many Pacific trucks in which you get Cummins as standard power.

WHITE 35-ton bottom-dump gravel hauler. One of thirty-four White-built trucks available with Cummins Diesels.

For over twenty years, major mine operators have picked Cummins Diesels as the top engines for heavy-duty off-highway trucks. Today, Cummins continues to be the first choice for the rough, tough haulage jobs.

Dependable day-in, day-out performance, ability to get more work done, long life, and lowest possible fuel and maintenance costs are a few of the reasons for this leadership.

In addition to heavy-duty earth haulers, Cummins Diesels are also available in smaller trucks used as dumpers in over-the-highway service.

When you buy new heavy-duty or medium heavy-duty mining trucks, get maximum efficiency . . . top profit. Specify Cummins.

CUMMINS DIESELS

give you the big plus

MORE PROFIT

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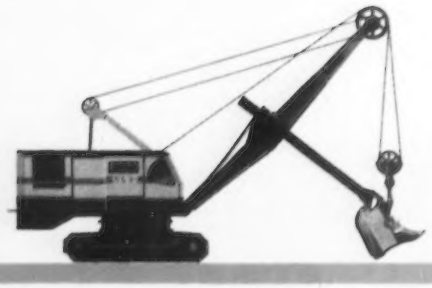
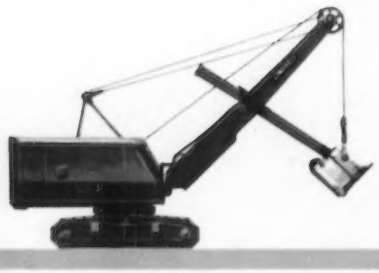
diesels now available

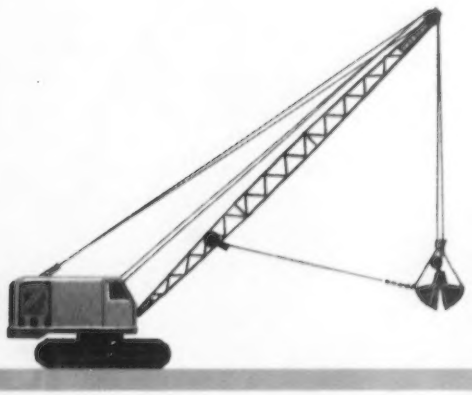


BUCYRUS-ERIE 2½-yard shovel. Cummins Diesels are also available in Bucyrus' 1½- and 4-yard shovels.

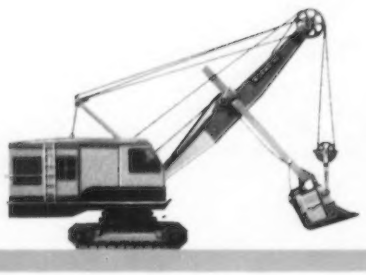


LINK-BELT SPEEDER 2½-yard shovel. Link-Belt Speeder also makes two draglines available with Cummins.

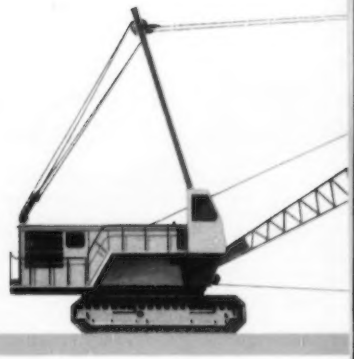
DOMINION backhoe. This unit, convertible to other front-end attachments, is available Cummins powered.



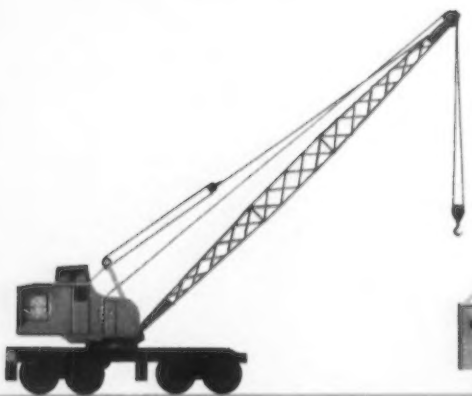
AMERICAN crawler crane. Cummins are available in the 700 series of American shovels, backhoes, and cranes.



KOEHRING 2½-yard shovel. A 275 h.p. Cummins torque converter package is available in this unit.

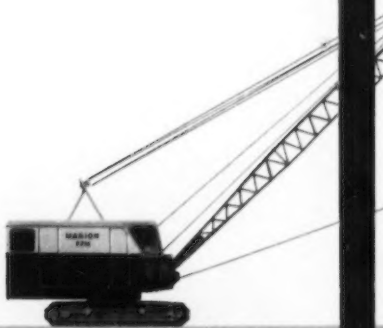


MANITOWOC 5-yard dragline. Manitowoc also powers five shovels (1- to 5-yard) and a crane with Cummins Diesels.



INDUSTRIAL BROWN-HOIST rubber-tired diesel-electric crane. Available in capacities from 25 to 60 tons.

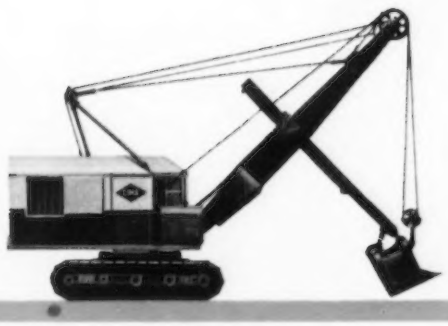
BAY CITY clamshell. Bay City's crane and 1½-yard shovel also feature Cummins Diesels as standard equipment.



MARION dragline. One of three draglines, six shovels (1¼- to 4-yard), two cranes—available with Cummins power.

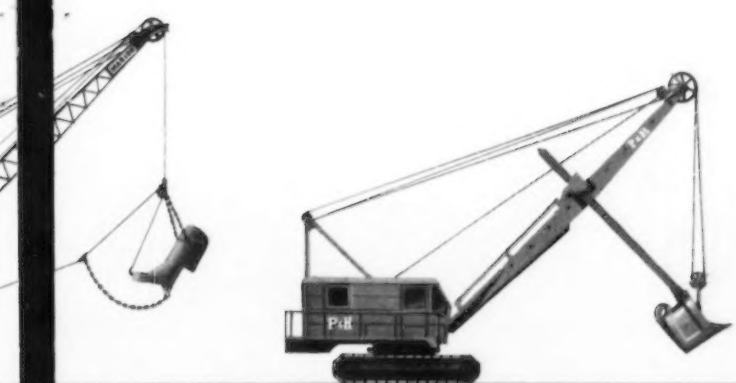
in these famous-make

SHOVELS
DRAGLINES
CRANES



LIMA 2½-yard shovel. Eight different Lima models (¾- to 4-yard) can be bought equipped with Cummins Diesels.

INSLEY 1-yard clamshell. Also as shovel, hoe, dragline, crane: on crawler, truck, or self-propelled mounting.



P&H model 1055 3½-yard shovel. Also available as a dragline, crane and clamshell. All available Cummins powered.

Cummins Diesels in your shovels, draglines, or cranes assure you of longer equipment life, lower maintenance and fuel costs . . . performance you can count on. That's why leading manufacturers make their ¾- to 5½-yard shovels available with Cummins Diesels.

Cummins engines for mechanical drive shovels have been engineered to include the best torque characteristics, controls, and accessories for each model of machine.

To assure best performance and lowest operating cost, torque converter units have been specially designed by Cummins to fit individual shovel models. Shovels equipped with Cummins torque converter units maintain power without lugging, stalling, or overspeeding. On the job, they have increased production by 30% to 50%. The hydraulic coupling effect of torque converter units also reduces maintenance costs on cables and machinery by absorbing shock loads.

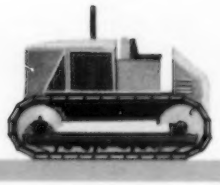
CUMMINS DIESELS
give you the big plus

MORE PROFIT

CUMMINS

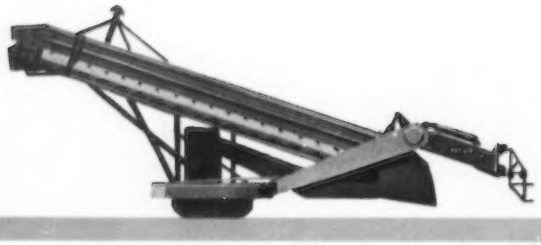
diesels now available

INTERNATIONAL HARVESTER model 75 Payscraper. Model 55 Payscraper is also Cummins powered.

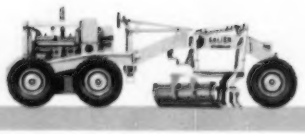


EIMCO model 105 crawler tractor. Eimco also makes a bulldozer and tractor-loader available with Cummins.

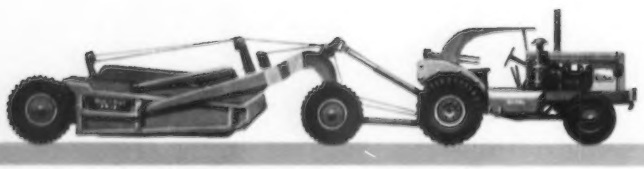
ADAMS motor grader. Adams division of Le Tourneau—Westinghouse offers its model 660 powered by Cummins.



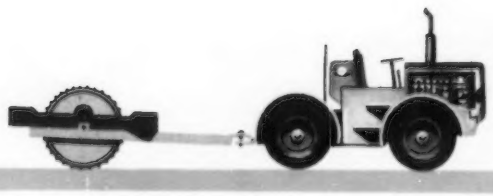
EUCLID loader. This Euclid belt-conveyor can be bought powered by a Cummins Diesel.



GALION model T-700 motor grader. This motor grader is available with a 190 h. p. Cummins as standard power.



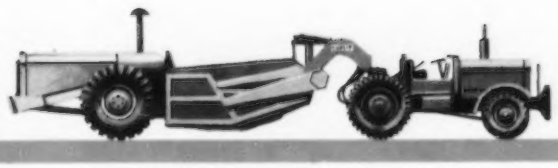
M-R-S four-wheel tractor. This is one of four M-R-S tractors available with Cummins Diesels.



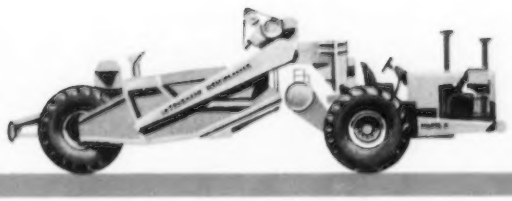
WAGNER 4-wheel drive tractor with sheepsfoot. One of two rubber-tired tractors available Cummins powered.

in these famous-make

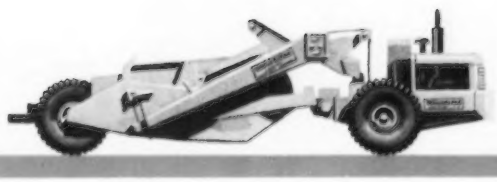
TRACTORS
GRADERS
SCRAPERS
LOADERS



EUCLID 18-yard twin-engine scraper. One of three Euclid scrapers you can buy powered by Cummins.



LE TOURNEAU-WESTINGHOUSE "B" Tournapull. Cummins also powers the "C" and a Tournatractor.



WOOLDRIDGE 18-yard "Terra Cobra" scraper. Seven "Terra Cobra" scrapers and dumpers use Cummins power.

Cummins Diesels give you the high torque needed for 'dozing, pushing, loading . . . fast acceleration . . . sustained high speeds on the haul. On mining jobs, you will find Cummins power in the rubber-tired tractors that pull the biggest scrapers—push the biggest 'dozer blades.

Cummins Diesels are now standard in 7 motor graders from 80 to 190 h.p. These machines do your grading and ditching jobs faster, better and more economically.

You now can get Cummins power in crawler tractors, too. Driving through a torque converter, a new 120 h.p. Cummins gives these tractors greater drawbar pull than all other tractors of their class—makes them outpull and outperform most tractors of heavier classifications.

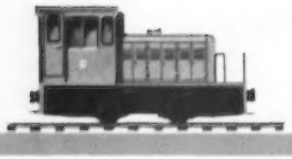
CUMMINS DIESELS

give you the big plus

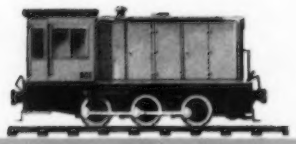
MORE PROFIT

CUMMINS

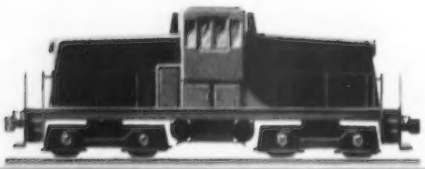
diesels now available



BALDWIN-LIMA-HAMILTON locomotive. One of six switching and mine locomotives available with Cummins power.



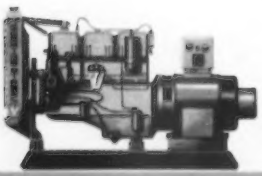
DAVENPORT BESLER DAVENPORT industrial switcher. Cummins Diesels are offered in nine Davenport models, from eight to sixty tons.



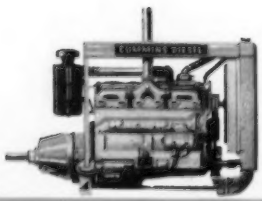
GENERAL ELECTRIC 80-ton industrial locomotive. A standard line of diesel electrics from 25 to 95 tons available Cummins-powered.

WORTHINGTON "Blue Brute" 315-foot rotary air compressor. Available powered by a Cummins 120 h.p. Diesel engine.

Standardize on Cummins for generators and power units, too!



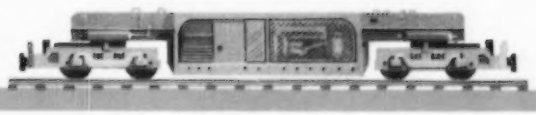
GENERATOR UNITS. Cummins makes lightweight, compact generator units—30 to 250 kw—adaptable to either portable or stationary applications. Simplicity of design minimizes installation expense. The low fuel consumption and small costs of maintaining Cummins Diesels are the reasons why power users have found that Cummins generator units give them the lowest cost per kilowatt hour.



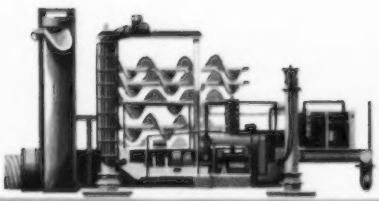
POWER UNITS. Cummins makes a complete line of rugged, heavy-duty industrial engines—60 to 600 h.p.—adaptable to an extremely wide range of applications, both portable and stationary.. These engines can be furnished as straight industrial units (fan to flywheel) . . . as complete power units with radiator cooling, hood, and clutch power take-off . . . or with a wide variety of accessories.

in these famous-make

LOCOMOTIVES
AUGERS
HOISTS
DRILLS



GENERAL ELECTRIC GENERAL ELECTRIC 40-ton underground locomotive. This unit comes powered by a Cummins 600 h.p. Diesel.



COMPTON COMPTON model 28 coal auger. One of five Compton coal augers you can buy powered by Cummins Diesels.

No matter what phase of mining work you specialize in . . . no matter what type of equipment you use most . . . you can be sure of maximum efficiency, *more profit* when you standardize on Cummins Diesels. There's no surer way of increasing production . . . cutting costs.

The mining equipment shown on these pages is only a sample of the wide variety of units available with Cummins power. All incorporate the latest engineering advances to let you do more jobs faster, better, and cheaper.

For further information, contact your Cummins Distributor or your equipment dealer, or mail coupon today.

CUMMINS DISTRIBUTOR
(See address on back cover)

I am interested in finding out more about Cummins Diesel advantages.

☐ Send me, free of charge, your directory of manufacturers offering Cummins Diesels in their equipment.

☐ I want details on repowering my present equipment. Please have your representative call.

Name_____ Position_____

Company_____

Address_____

CUMMINS DIESELS
give you the big plus

MORE PROFIT

Here's what you get

when you standardize on Cummins!

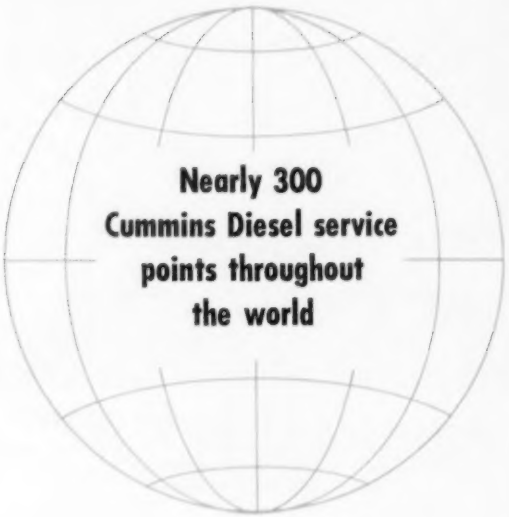
Maximum Equipment Availability — Cummins rugged basic engine design has the proven superiority of the 4-cycle operation. High-strength metals and alloys (Stellite valve seat inserts, on *both* intake and exhaust ports, for example) cut scheduled maintenance and unscheduled downtime to a minimum.

Greater Diesel Economy—Use Cummins Diesels as standard power in your machines . . . and you are assured of maximum fuel and maintenance economy. Over 150 models permit pinpoint matching of power to job.

Cummins PT Fuel System—Cummins exclusive PT fuel system drastically reduces fuel system maintenance costs while permitting the engine to operate at top performance. It is easier to understand and service than any other diesel or gasoline fuel system.

Interchangeability of Parts—Wherever possible, Cummins has standardized internal engine components (bearings, pistons, crankshafts and many other parts). This lets you keep a smaller parts inventory . . . reduces your dollar investment in parts.

Export Service and Parts Help — Cummins worldwide distribution network — devoted to the sales and service of Cummins Diesels — keeps factory-type maintenance and genuine Cummins parts near at hand. Special service and parts availability at job-site is another big plus.



Over 45 famous manufacturers of heavy equipment offer Cummins Diesels as power in over 200 models.

CUMMINS MORE PROFIT

gives you the big plus

Printed in U. S. A.

CUMMINS ENGINE COMPANY, INC.

Columbus, Indiana

Export: Cummins Diesel Export Corporation

Columbus, Indiana, U.S.A.

Cable: CUMDIEX

TIREX CABLES strip high costs from maintenance

Wherever there's mining, you'll find Simplex-TIREX cords and cables used on the toughest jobs.

You'll see them supplying power for light—transmitting track signals—feeding drills, loaders, coal cutters, shuttle cars, feeders and electric locomotives.

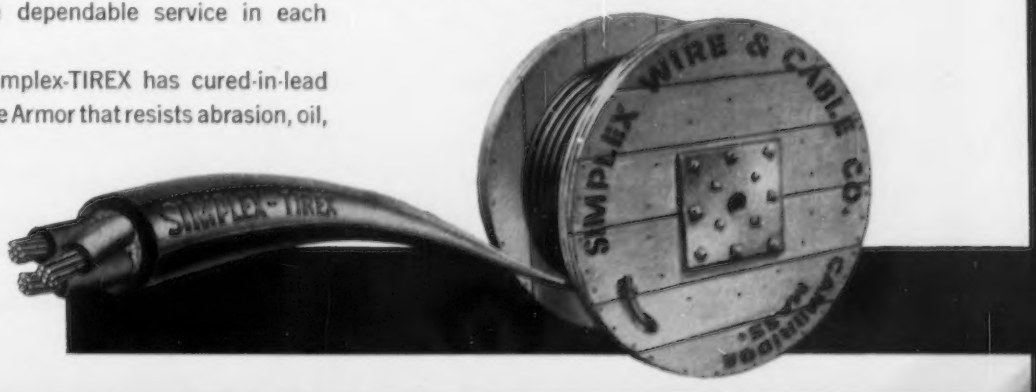
Such universal use is based on several facts:

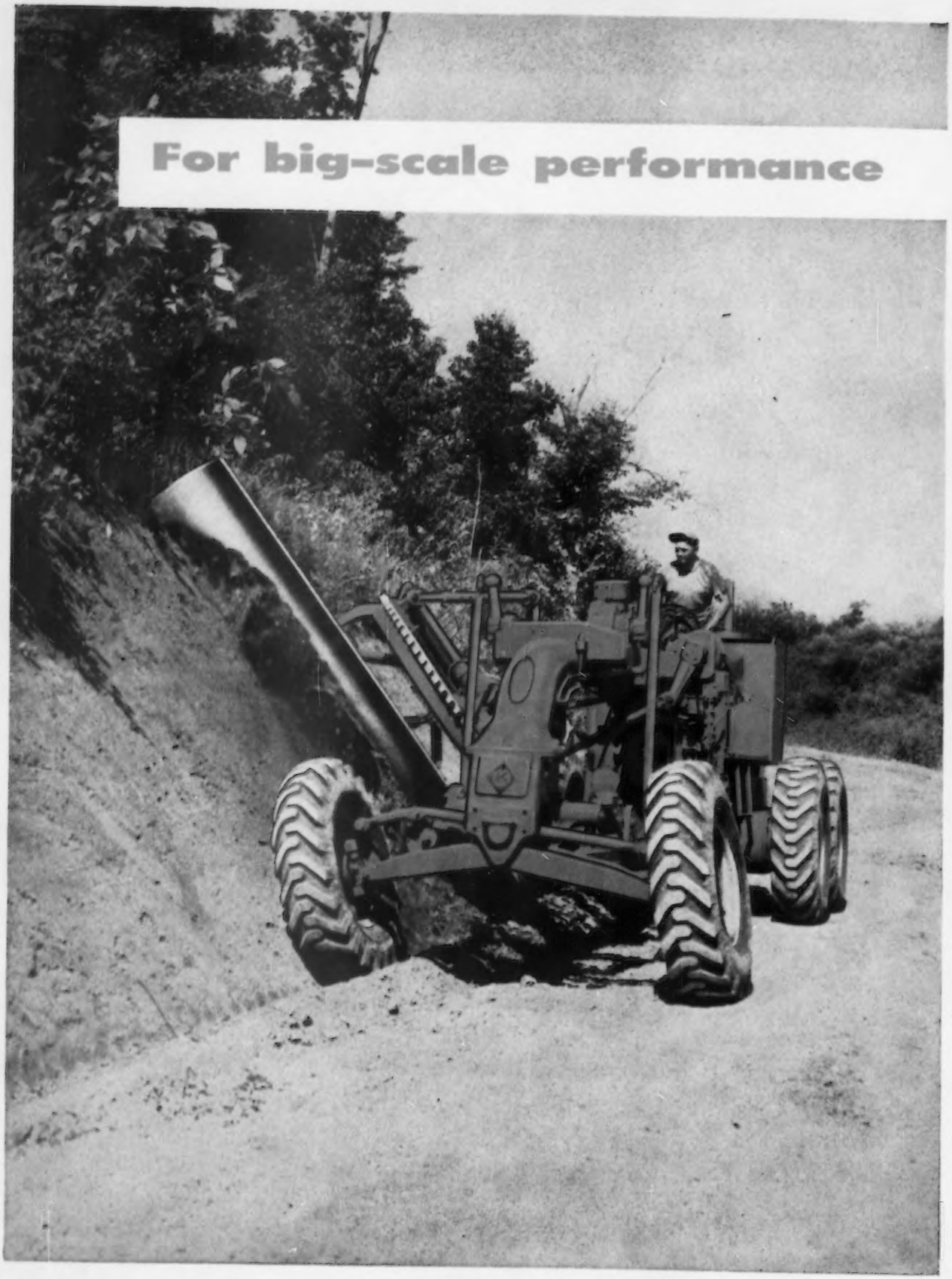
First, Simplex Wire & Cable Company makes famous TIREX in a wide range of sizes, each designed to provide dependable service in each application.

Second, only Simplex-TIREX has cured-in-lead Selenium Neoprene Armor that resists abrasion, oil, flame and water. Yet it is smooth, snagproof, flexible.

Third, Simplex-TIREX bears the "P-101-BM" markings—performs dependably and safely over longer periods.

Simplex-TIREX Cords and Cables are available at most mining supply houses and electrical distributors. Be sure to specify "Simplex-TIREX"—it's the only "TIREX". **SIMPLEX WIRE & CABLE CO.,** 79 Sidney Street, Cambridge 39, Massachusetts.




For big-scale performance

on all grading jobs

SEE THE Forty Five BEFORE YOU BUY

Here's motor grader design that pays off in extra output on today's tougher, more precise jobs. You get these big advantages when you put the FORTY FIVE to work for you—more power at the wheels, more dirt at the blade, plus precision control and ease of operation.

Allis-Chalmers diesel engine with follow-through combustion provides real lugging ability . . . responds quickly to varying load conditions . . . has the power with tandem drive to pull through soft spots, roll big windrows, peel off that last inch of tough, hard dirt.

ROLL-AWAY moldboard reduces friction drag by rolling the load up and ahead of the blade edge . . . moves more dirt with less effort . . . makes more efficient use of engine power on sloping, rough grading, stripping and other heavy-duty construction and maintenance jobs.

Toggle-type controls give the operator fingertip command of every blade position, every job. Exclusive mechanical toggle-type action provides a positive "feel," yet operation of moldboard components, scarifier and front wheel lean is accurate and easy.

Get a demonstration of the FORTY FIVE from your Allis Chalmers dealer . . . let him show you how fully-enclosed power steering, accelerator-decelerator pedal, "box seat" comfort and visibility, and other features give you an extra measure of performance on all your grading jobs. And check the complete service program he offers you . . . factory-trained servicemen and True Original Parts for high-quality service, continued top performance and long equipment life.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION
MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

ROLL-AWAY is an ALLIS-CHALMERS trademark

Forty Five

120 brake hp

23,800 lb

6 forward speeds to 20.6 mph

3 reverse speeds to 7.0 mph

Westinghouse-equipped ore unloaders break record by 436 ton-hours

Rugged Hevi-duty mill motors and SA brakes take tough shock treatment at 2350 tons an hour

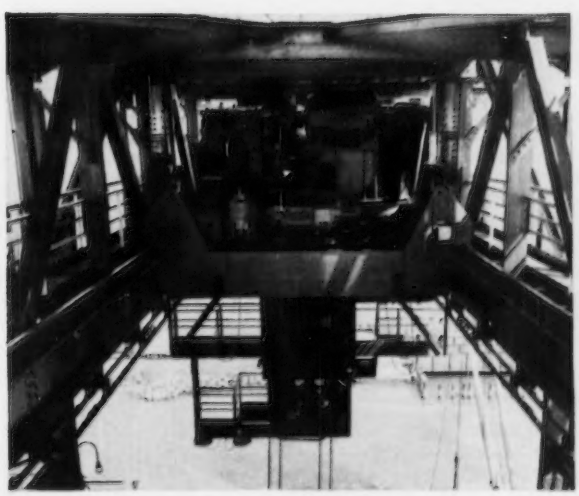
Westinghouse d-c motors with larger shaft diameters between rigid bearing supports are designed and built to break records in rugged operations like this.

This is just one reason why Westinghouse motors were specified by the Pennsylvania Railroad when a new ore unloader was needed to increase the production capacity. Another reason was the superior service record of Westinghouse motors on the unloaders already in use.

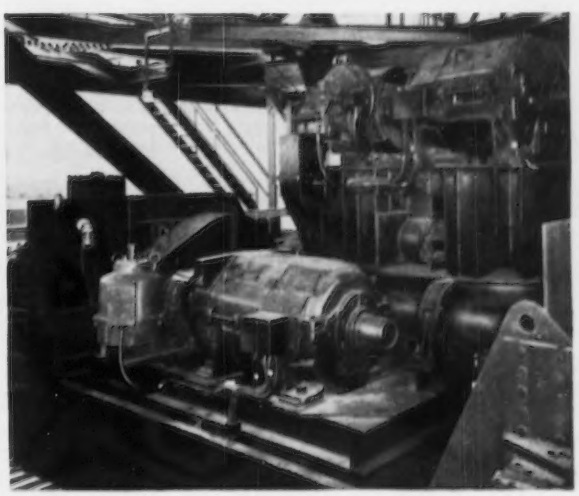
It will pay you to investigate the many other equally important factors about Westinghouse d-c motors and brakes that mean longer life and dependability. You can get all the details from your Westinghouse sales engineer. Call him today. J-21928

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***



Three million tons of ore in 1955 and production is still going up this year! The ability of Westinghouse motors and brakes to stand up under continuous loading and reversing duty makes them first choice for grueling operations like this.



Here is the heart of an ore unloader—Westinghouse Hevi-duty 600 Series mill motors and SA (self-adjusting) d-c brakes. Westinghouse engineers are ready to work with you to determine the characteristics you need for motors, controls and brakes.

Here's the drill you need for LARGER, LOWER-COST BLASTHOLES

Joy 60-BH Drill in operation in a large Southwest copper mine.

the JOY 60-BH Super Heavyweight Champion

For high-production open pit mining of copper, as illustrated above, large-diameter blastholes are a *must!* The way to drill those large-diameter holes economically—either in copper ore, or in any other open-pit mining or overburden removal job—is with the Joy 60-BH Super Heavyweight Champion. Here's why: because this Joy rotary drill excels in all three of the features which determine bit penetration:

ROTATION—Infinite variation of bit speeds, accurately controlled bit speeds, more power on bit rotation, and constant indication of bit speed and pressure by gauges.

BIT WEIGHT—The Joy hydraulic feed, using two 5-foot hydraulic cylinders, is the most efficient and dependable method of applying bit pressure. It is more accurately controlled and less hazardous than other methods.

CUTTINGS REMOVAL—Only Joy uses a heavy-duty, industrial-type, water-cooled air compressor to insure more dependable air supply required for efficient rotary-air blast drilling.

Other features include a self-aligning hydraulic automatic chuck, hydraulically raised and lowered derrick, and rod handling device.

The 60-BH, capable of drilling 9" to 12" diameter holes in even the hardest rock formations, is the largest in the outstanding line of Joy Champion "rotary-air blast" drills. Smaller models are the 58-BH Heavyweight for 7⅞" diameter holes, and the 56-BH Middleweight for 6¼" diameter holes. Let us quote on *your* requirements. *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 35-4

Consult a Joy Engineer

For AIR COMPRESSORS, ROCK DRILLS, CORE DRILLS, HOISTS and SLUSHERS, MINE FANS and BLOWERS

WBW MSB06-58

JOY

WORLD'S LARGEST BUILDER OF CORE DRILLS, ROTARY BLAST HOLE DRILLS AND MOTORIZED DRILL RIGS

Do you have this kind of haul problem?

180° switch-backs...narrow, steep, one-way haul roads...tight quarters

The Standard Slag Co., of Youngstown, Ohio are tackling some tough hauling problems at their magnesite ore mine, at Gabbs, Nevada. One mile, one-way haul road is narrow and steep, with sharp 180° switch-backs...loading is on narrow benches, dumping areas have restricted access. Compact, highly maneuverable machines were needed to handle the job ...Standard picked 2 D Tournapull Rear-Dumps for the assignment.

Turns within 12'4" radius

Teamed with a ¾-yard Northwest shovel, the rubber-tired "D's" were opening up a bench for loading when photos were taken. Carrying 11 tons of waste rock, the Rear-Dumps hauled to a narrow 15-ft. wide area where material was dumped over a 100-ft. bank. When full scale mining operations begin, company officials report that the "D's" will haul 500 tons of ore daily to the crushing plant over the winding mile-long road notched into the mountain side.

The two Model D Rear-Dumps have replaced three 8-cu. yd. trucks and are operating at lower hourly cost than the trucks. Records show that, excluding cable, repair parts cost only $257 during 13 machine months use.

Easy to control

"D's" on this job reduce the "hard-work" element by simple fingertip electric controls. Operators have no big steering wheels or manually operated shifts and levers to fight... fatigue is greatly reduced. Operator C. E. Metcalf reports, "These 'D's' are very easy to control. In fact they are easier to operate than trucks." The Superintendent on the job said, "The D Tournapull Rear-Dumps can't be beat on our narrow bench job."

Safer than trucks

You'll find as did the Standard Slag Co., that D Rear-Dumps are safer than any trucks where loading, hauling and dumping areas are limited. Three important reasons why "D's" offer greater safety are:

1. multi-disc air brakes with 2,822 sq. in. of braking surface...more braking surface on a single wheel than most haulers have on all four;

2. positive power steer through geared king-pin which gives 90° turning, and sure safe control at all times;

3. front-wheel drive which keeps power and traction on solid footing well ahead of rear wheels during dumping. These safety features give operators more confidence on steep grades and narrow roads, as well as when dumping loads over high banks.

¾-yard shovel loads "D" with 11 tons of waste rock. 90° turning ability of unit allows quick spotting on narrow shelf...wide target permits faster loading.

With front-wheel drive and powerful 4-wheel brakes, unit backs safely to edge of 100-ft. bank...dumps load clean at touch of switch.

Check the advantages of D Rear-Dumps for yourself. See how their maneuverability can speed cycles, cut costs, and increase your profits. Write or call for a demonstration today!

Tournapull—Trademark Reg. U.S. Pat. Off. DR-915-M-b

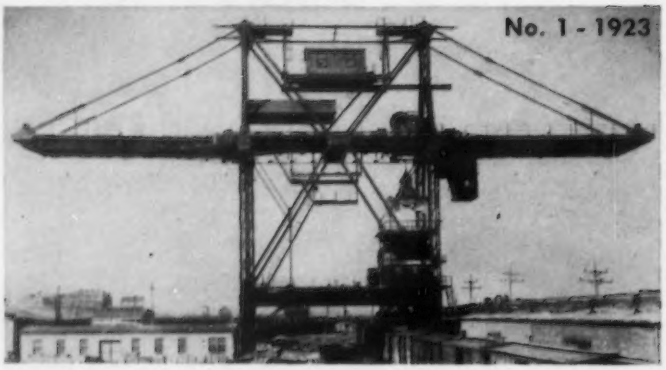
LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

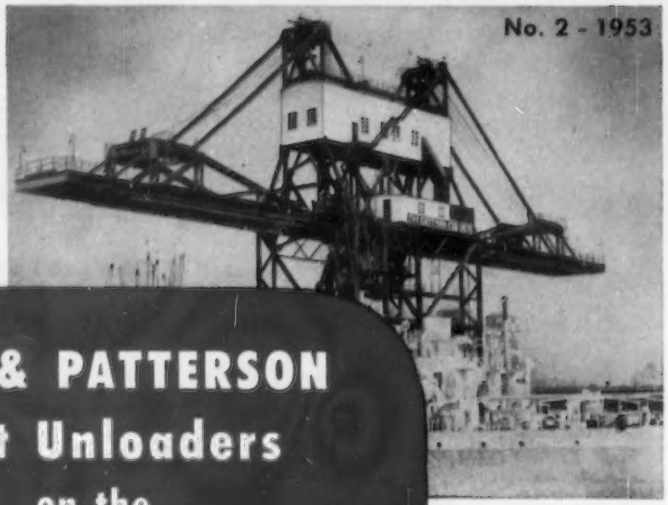
1

The No. 1 H & P Boat Unloader has been operating efficiently since 1923 for The Cottman Company, operating Subsidiary of The Canton Co.



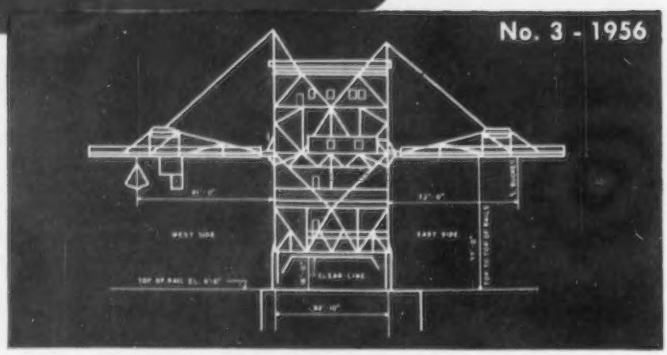
2

The No. 2 H & P Boat Unloader has been in operation since 1953.

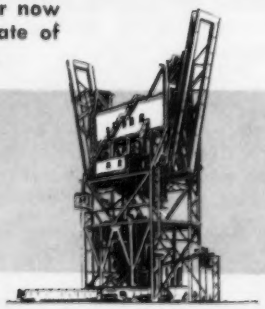


3 HEYL & PATTERSON Boat Unloaders on the CANTON RAILROAD ORE PIER

These three unloaders, located on the Canton Company Pier in Baltimore, are capable of unloading all kinds of ore directly into railroad cars or onto a high-line belt conveyor for remote loading into cars. All these unloaders are equipped with turntable trolleys to promote speedy cleanup, thus providing minimum turnaround time for both small and large carriers. The second and third Heyl & Patterson Unloaders are practically duplicates and employ the latest structural, mechanical and electrical design features.



The No. 3 H & P Boat Unloader now being built, is almost a duplicate of the No. 2 H & P Boat Unloader.



Heyl & Patterson INC.

55 FORT PITT BLVD. • PITTSBURGH 22, PA.
PHONE COurt 1-0750

At Oro Grande, California

▲ Oversize pieces of limestone are readily pulled out of the blasted material and segregated for breaking.

▲ One of Tournatractor's jobs is moving equipment. Machine easily and quickly tows this heavy drill from one blast site to the next.

One fast rubber-tired tractor takes over all quarry clean-up ... speeds production

In Riverside Cement Company's limestone quarry at Oro Grande, California, there are many scattered jobs that must be done quickly, without interference to production. These jobs include clean-up around quarry shovels, leveling waste dumps, dozing overburden, towing other equipment around the quarry.

To do this variety of jobs at its Oro Grande property, Riverside Cement Company, of Los Angeles, first tried a 150 hp, 5.8 mph crawler tractor. They found the machine too slow. It couldn't get around fast enough to do its varied assignments.

More work done in less time

Recently Riverside Cement Company purchased and placed in service a 19 mph, 208 hp, rubber-tired Tournatractor. With the increased speed and flexibility of this unit, Riverside finds that critical jobs can now be completed in less time than before; eliminating production delays, cutting costs.

Big rubber tires "cushion" shock

Working on rocky quarry floor, the big, low-pressure Tournatractor tires absorb shock, ride smoothly over rough going, with minimum "wear-and-tear" to operator and machine. And Tournatractor's power-train is sealed against quarry dust and gritty materials. Lubricants are kept clean and free from abrasives, damage and wear to bearings and moving parts is prevented, maintenance time and expense is reduced.

Investigate Tournatractors

For fast, all-around mine and quarry duty, investigate the highly maneuverable Tournatractor. Let us send you some owner-verified reports on Tournatractor performance. Write for full details.

▲ Tournatractor's 19 mph speed handles shovel clean-up in a hurry... cuts work delays... increases daily output. Rubber-tired tractor "outruns" crawler 2-to-1.

▲ Air compressors, and other mine equipment, moved fast from one job location to another. Tournatractor gets more work done, fast, at low operating cost.

Tournatractor—Trademark Reg. U.S. Pat. Off. T-872-Q-b

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

Alabama By-Products Corporation Installs *Continental* Belt Conveyors at Its Large, Modern MAXINE MINE

Underground belt conveyor, as seen from slope bottom, carries coal to surface cleaning plant.

Overland belt conveyor transports coal from cleaning plant to dock loading stations.

The new Maxine plant of the Alabama By-Products Corporation, located about 30 miles west of Birmingham on a fork of the Warrior River, was designed to process American seam coal mined underground into a product specifically suited for utilization in electric utility steam plants.

Maxine mine is Alabama's newest and one of the South's largest. It is also one of the nation's most fully mechanized mines, employing the latest type of continuous mining equipment.

Coal is fed by a 42" CONTINENTAL slope-belt conveyor to the modern plant on the surface. Part of the output is then transported overland 2500 feet on 30" CONTINENTAL belt conveyors to a dock loading station, thence down to the river barges. The remainder is loaded into railroad cars.

Maxine is one of the many large modern, mechanized mines where Continental Belt Conveyors are doing an outstanding job. For complete information on this equipment, write for Bulletin ID-481A.

CG-5603

Continental Idlers — A Few of Many Types

Standard Duty Idler

Rubber Disc Impact Idler

Rubber Tired Impact Idler

Self-Aligning Troughing Idler

Self-Aligning Flat Belt Idler

INDUSTRIAL DIVISION

CONTINENTAL GIN COMPANY

BIRMINGHAM, ALABAMA

ENGINEERS — ATLANTA • CLEVELAND • DALLAS • KNOXVILLE — MANUFACTURERS

MEMPHIS • NEW YORK 17, NEW YORK

Moving fast, this 550 Adams grader keeps pit floor clean, saving wear on fleets' tires and treads. Permits driving equipment by shortest routes, improves drainage.

This high-speed modern grader keeps haul-roads in first-class condition to speed movement of production haulers, reduce wear on tires and machines.

Cut mining costs thru better clean-up

There are only two ways to increase your mining profits without a rise in the price of ore. You must increase production, or lower costs...or both.

You may think of your grader simply as a maintenance tool. But in the hands of a good operator, a versatile, modern high-speed grader increases mining production and cuts operating costs. Check these 9 big ways increased grader capacity can increase your profits.

Occasional spill over sides of heaped trucks ...around hoppers, grizzlies, conveyors, and trestles...can litter concentrating plant area, slow traffic, damage tires. This Adams grader keeps this area clean by daily clean-up.

1. ***Regular and more frequent maintenance of haul roads*** — smooth roads speed hauling, save tire-wear, cut mechanical maintenance, improve safety.

2. ***Quick clean-up after blast***—grader provides a fast, inexpensive way to move scattered fragments back against toe, thus protecting men, machinery, and tires working around pit, speeding up all pit operations.

3. ***Clean pit floors*** — regular routine of maintaining wide traffic ways that make all areas of pit quickly accessible pays off. Equipment can travel to any assignment by shortest route. Smooth access saves wear on tires and crawlers, improves drainage, prevent dirt and refuse from weathering into levels of ore below floor.

4. ***Maintain good housekeeping around plant***—you need ample grader capacity to keep roads, runways, working areas around plant neat, clean, and workable at all times. Level or remove the occasional spill left by heaped trucks...from around hoppers, grizzlies, conveyors, trestles. Clean plant area speeds all mobile equipment operation around plant, reduces dust, improves safety.

5. ***Keep stockpile toes pushed in*** — weather and loading operations result in spread of toes around stockpile. This limits working space, wastes stored material. Also, working thinly-spread toes means inferior ore grades, increases loading cost. Regular grader service helps prevent this waste.

6. ***Keep dumps smoothly spread and level*** — regular grader service can spread dumped material clear over edge. Offset blade reaches far beyond leaning front wheels which hold against side thrust. A smooth, level, dry dump speeds hauling and dumping, cuts equipment costs. Grader can smooth haul road coming and going.

7. ***Clean ore benches of washed-down dirt*** — every rain washes dirt into upper benches, lowers ore grade. Prompt grader service halts "wash", provides planned drainage, piles washed-in material for easy removal by scraper or truck.

8. ***Assist exploration teams*** — a modern grader can build a well-graded and drained roadway in a matter of hours, speeds exploration work by maintaining good haul roads.

9. ***Keeps drainage open*** — in a few hours work per week, a modern grader will keep ditches clean, pit dry.

Inventory capacity of your present graders

It will pay you to inventory the work capacity of your present graders. If they are more than a few years old, you will probably find a substantial saving in replacement with the faster, more powerful, big capacity graders currently on the market. We will be glad to assist by furnishing specifications and comparative statistics on our line of modern Adams graders.

Reprints available on request.

AG-34-M-b

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

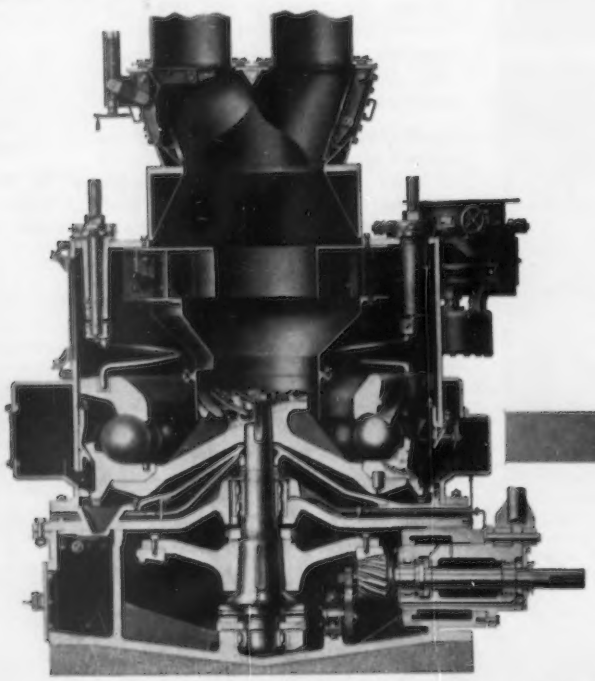
A Subsidiary of Westinghouse Air Brake Company

B&W Fuel-Handling, Fuel-Burning are Cutting Processing Costs in Metallurgical Plants

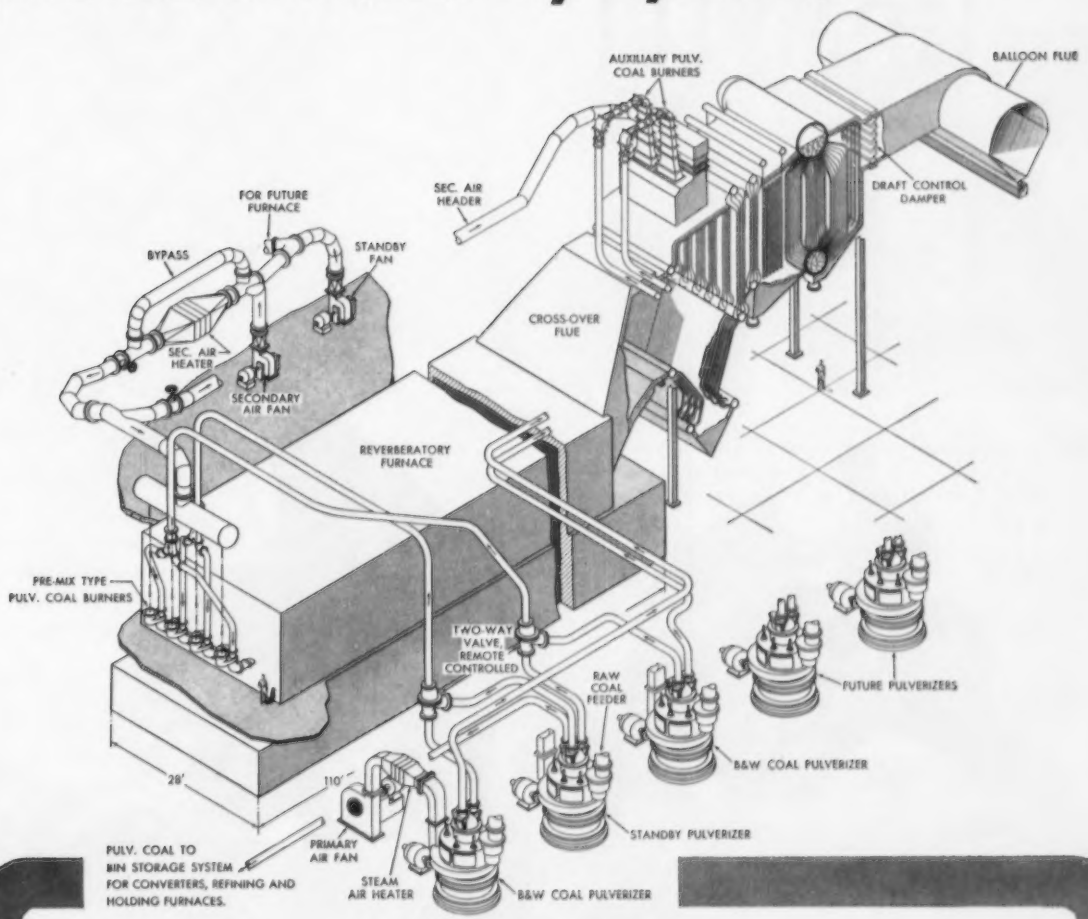
PULVERIZED-COAL FIRING

B&W Direct-Firing and Circulating Pulverized-Coal systems are serving industrial furnaces of various capacities. Although these furnaces are often located in separate areas throughout a plant, the coal supply to each can be independently controlled from a central pulverizing system.

The solution of unusual problems common to firing industrial furnaces with pulverized coal is one of a number of plus values that can promote higher production, lower operating cost, and reduction of furnace maintenance. For plant expansion, modernization of metallurgical fuel-fired furnaces, and waste-heat recuperation, B&W offers broad research, engineering and production experience.



and Heat-Recovery Systems



HEAT RECOVERY

The reverberatory furnace, waste heat boiler, and pulverized coal firing equipment shown above are a part of a fully integrated mine, mill, and smelter, started up in 1955 to produce 75,000,000 lb of fire-refined copper annually from low grade chalcocite ore.

The firing equipment is arranged with ample standby capacity to provide uninterrupted operation of the reverberatory furnace. During regular maintenance shutdowns on the furnace, continuous steam generation can be maintained by firing the boiler with the auxiliary coal burners.

Modern boiler design permits uninterrupted furnace operation with a single boiler, eliminating the problems of a two-boiler arrangement with its costly cross-over flue design and refractory maintenance.

Heavily dust-laden, high-temperature, corrosive gases from the reverberatory furnace are easily handled in this streamlined, single-pass boiler under natural draft.

Low draft loss, elimination of external corrosion and effective cleaning are accomplished with remote automatic steam soot blowers. *The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York, 17, N. Y.*

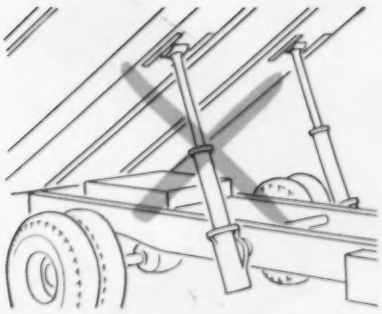
BABCOCK & WILCOX

BOILER DIVISION

Q-791

GRAVITY dumps the load...in

ONE second



Koehring Dumptor® has no body hoist

Operator drives up, trips the body-release lever — and *gravity* tilts the 6-yard body 70 degrees. One second later the load is out, and Dumptor is on its way back for the next load. It's as simple and fast as that!

There's no 15 to 25-second wait for slow-acting body hoists — no expensive hoist replacement parts, maintenance or down-time. And, you get the same one-second dumping *every time,* under heaviest loads, in all temperature extremes, because Koehring *gravity-dump* never balks — never wears out.

One-second dumping earns a substantial increase in yardage output, too. For example — take a typical 1,000-foot haul where you would normally make 16 trips an hour. By saving an average of 20 seconds dump-time on each trip, Dumptor gains 320 seconds, or 5.3 minutes more productive haul-time per hour. You get 17½ trips, instead of 16. This, alone, adds 9% to hourly production.

This saving is typical of Koehring Dumptor's basic principle — to reduce all non-productive time to a minimum — to increase work-time for more yards per day. See Koehring distributor for complete information.

KOEHRING COMPANY

MILWAUKEE 16 WISCONSIN

X640

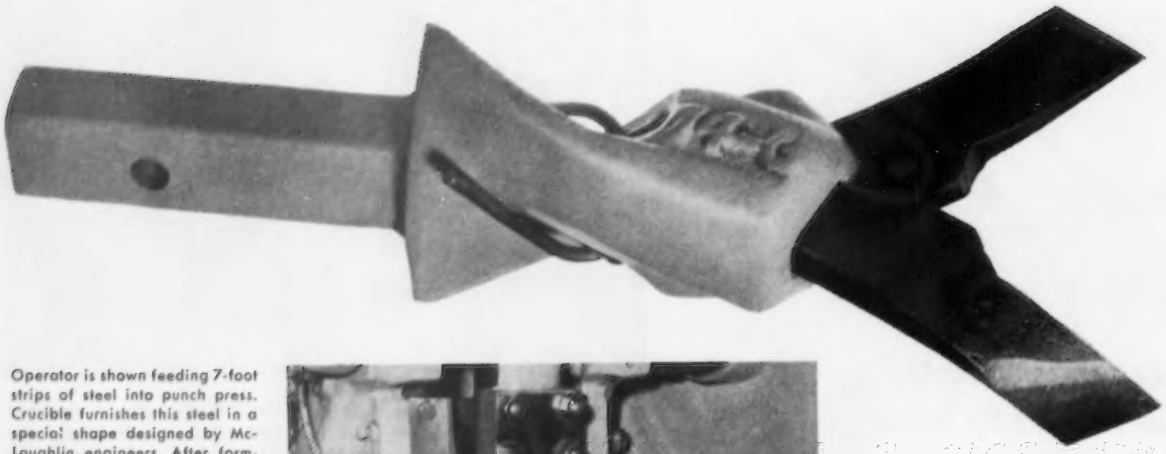
Subsidiaries: JOHNSON PARSONS KWIK-MIX

Saves 20 seconds every time it dumps — **Heaviest loads are dumped instantly. Tilting Dumptor body rolls on heavy-duty rockers. Snub chains attached to big shock absorbers check the body at approximately 70-degree tilt.**

Shuttles back and forth without turning — **Dumptor operates with equal ease in either direction. Constant-mesh transmission gives the same 3 travel speeds forward and reverse. Every turn eliminated cuts 15 seconds off cycle time.**

64 square-foot loading target — **Big, square body opening permits loading over either end or sides. Top edge and bottom are box-beam constructed. Sides, ends, heavily rib-reinforced. ½"-thick kick-out pan bolts to floor for rock work.**

Bits of Crucible Silicon-Manganese alloy steel shown in holder. They are produced by McLaughlin Manufacturing Co., Inc., Joliet, Illinois.



Operator is shown feeding 7-foot strips of steel into punch press. Crucible furnishes this steel in a special shape designed by McLaughlin engineers. After forming to finished size, the bits are heat treated and the point and cutting edge are sharpened by hand.

special CRUCIBLE alloy steel

gives bits maximum impact and abrasion resistance . . .

Cutting through abrasive materials like coal, soft limestone and shale demands a *special* steel. A steel that's hard without being brittle – that will take and *hold* a keen edge.

That's why Crucible produces a *special* Silicon-Manganese type alloy steel for the McLaughlin Manufacturing Co., Inc., manufacturers of these bits. It's a steel designed for optimum shock and abrasion resistance.

After McLaughlin tested Crucible's special alloy in the coal fields, their verdict was "This Silicon-Manganese steel is the finest alloy steel available."

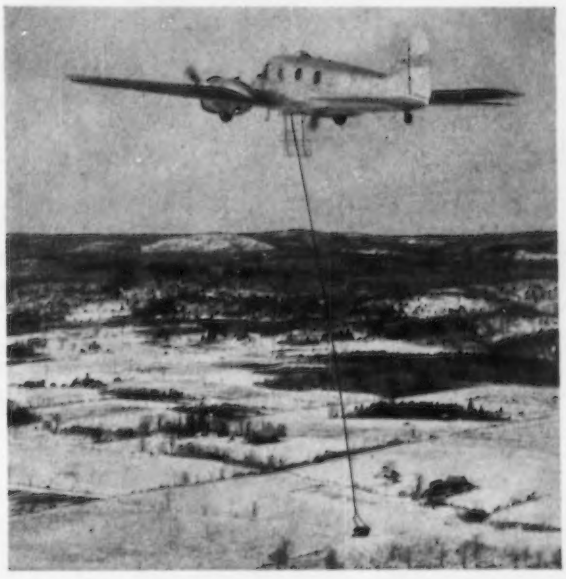
Crucible will be glad to produce a *special* steel to meet your particular needs, too. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

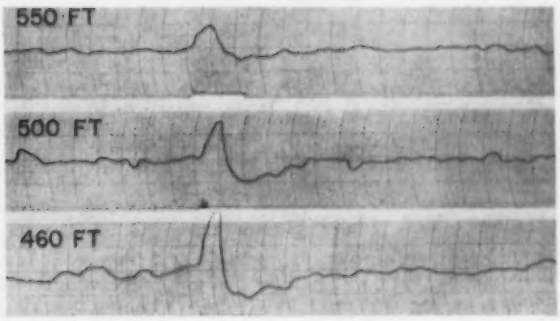
CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

LLOYD E. ANTONIDES, Assistant Editor





ANOMALY remains distinct though altitude varies 90 ft.

◄ **UNUSUAL** "bird" picks-up data on 100 mph reconnaissance.

Aerial EM Exploration (1)

Unique "bird" is used in aerial electro-magnetic exploration service offered by Aerophysics of Canada Ltd., Ottawa, Can. New organization consists of three veteran companies: Canadian Aero Service Ltd., McPhar Geophysics Ltd., and Spartan Air Services Ltd. Method is said to be especially applicable to base metal (sulphide) exploration as deep as 300 ft. Normal EM field, produced by ac transmitter coil in rear of aircraft fuselage, is distorted when near conductive bodies. Coil towed at end of trailing cable picks up resultant field.

Bird, nicknamed "flying stovepipe," is not usual streamlined object. In this case, it is simply a cylindrical tube about 1 ft diameter and 2 ft long. Long axis of bird (and coil) is maintained transverse to flight line by stabilizing fins on ends of tube. In aircraft, flat transmitter coil is mounted vertically with wires parallel to flight line.

Air survey over large areas reputedly costs about one-tenth of ground work and at rate of 100 mph versus 2-3 miles per day. System simultaneously records EM trace, altitude and vertical photo of ground, thus indicating areas worthy of more detailed surface work.

Tractor (3)

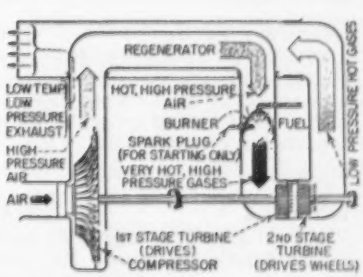
Crawler tractor with ground pressure of only 3.4 psi—less than half that of standard model—has been developed by U. S. Army Corps of Engineers' lab at Ft. Belvoir, Va., to tow supply "trains" over winter snow and summer muskeg in Arctic. Made by Peterson Tractor & Equipment Co., San Leandro, Calif., 225-hp unit has treads 106 in. by 54 in.

Mapping Instrument (2)

Camera tilt and elevation distortions are eliminated from aerial photos with "orthophotoscope," announced by U. S. Geological Survey. Projection of vertical or oblique stereo-pair is scanned by operator using narrow slit to produce new distortion-free negative. Scaled distances can be used with vertical angles taken in field for vertical control. Heretofore, distances could be scaled accurately only on map made from photos.

Blasting Wire (4)

Aluminum connecting wire for blasting is available from Coleman Cable & Wire Co., Chicago, Ill. Plastic covered, No. 18 wire is equal in electrical characteristics to conventional No. 20 copper wire, it is said. Claims of 32% savings in basic cost and 37% lower shipping costs are made. Company says field tests prove it fully acceptable.



Gas Turbine Engine (5)

Chrysler Corp., Detroit, Mich., has installed gas turbine engine on standard Plymouth sedan. Test car will tour country and obtain performance data. As company says, other automotive applications are expected since it is mechanically simpler, can use wide range of fuels, is lighter, needs no radiator, has simple ignition and needs less maintenance.

Drilling Combine (8)

DH143 is 5½-in. rock drill for 3½- to 5-in. holes just announced by Gardner-Denver Co., Quincy, Ill. Mounted on an air-powered crawler rig and teamed up with new Rotary 900 portable compressor, it is reported a highly versatile combine. Mast, for 20-ft changes, "dumps" to −15 deg on toe holes or up to +10 deg if collared 10 ft up face.

Shovels and Cranes (6)

Thew Shovel Co., Lorain, Ohio, announces two features now on some of its power shovels and cranes: Air-ease air controls for operating friction clutches; and all-welded crane booms with main cords of square tubes and lacing of round tubes. The first cuts manual effort and reduces controls from four or more levers to just two. The second cuts weight while increasing strength.

Seismograph (7)

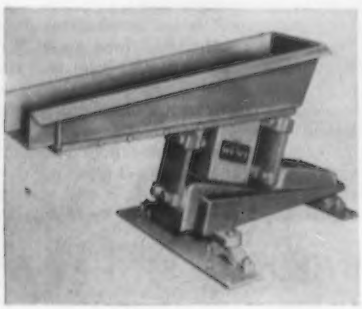
Seismolog is compact portable seismograph for recording industrial vibrations from blasting, etc. Developed by Vibration Measurement Engineers, Chicago, Ill., unit gives photographic record and needs no specially trained operator. Key to portability is lightweight power pack by General Dry Batteries Inc., Cleveland, Ohio.

Scrapers & Tractors (9)

International Harvester Co., Chicago, Ill., has re-engineered two self-propelled wheeled scrapers and four models of their crawler tractor line. Besides an over-all "new look," they use a cerametallic clutch facing, claimed more efficient. Pay-scraper bowls are reported larger and better loading while tractor horsepowers are upped.

Rotary Drill (10)

Hydraulically powered core or auger drill, B-40 by Mobile Drilling Inc., Indianapolis 4, Ind., may be driven by power take-off or its own engine. One man operated unit is said to core to 200 ft and auger to 75 ft at any angle, and to be light enough for air transport. Either air or water may be used with hollow stem augers for hard formations.

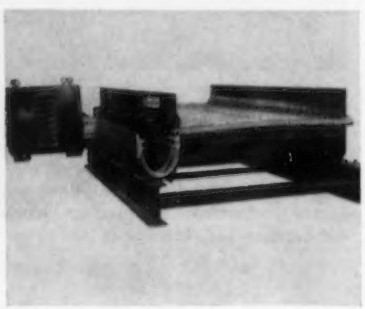


Vibratory Feeder (11)

Drive on HI-VI feeder by Eriez Mfg. Co., Erie, Pa., combines electro-magnet with permanent magnetic armature and energy stored in steel springs to power both strokes. Largest handles 10 tph.

Switch Engine (12)

Switchmobile by LeTourneau-Westinghouse Co., Peoria, Ill., is equal in power to conventional 50-ton switch engine and can roll down city street or over tracks without damage to ties.



Vibrating Screen (13)

For handling damp or sticky materials, Model SS heated vibrating screen has been developed by Simplicity Engineering Co., Durand, Mich. Better heating and better vibratory action is claimed.

Lift Truck (14)

Claimed as first gas powered lift truck approved for use in certain hazardous atmospheres, KG-51 is announced by Yale & Towne Mfg. Co., Philadelphia, Pa. No-spark muffler is one feature.

Lifting Magnet (15)

Aluminum wire coils make LA series of circular lifting electro-magnets lighter weight says F. W. Shrader Co., Los Angeles, Calif. Designed for handling light scrap, they are sized 38 to 78 in. diam.

Fork Truck (16)

For lumber handling and heavy outside work, YL-150 fork truck is offered by Clark Equipment Co., Battle Creek, Mich. It has 15,000-lb capacity, dual wheel drive and is pneumatic tired.

Self-Potential Unit (17)

A one-man unit for self-potential geophysical surveying is announced by Universal Atomics Corp., New York, N. Y. One model has vacuum tube voltmeter reading to 0.1 mv for dry soil.

Radiation Detector (18)

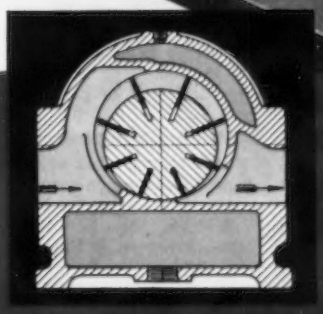
Built-in loudspeaker alarm is feature of scintillation counter Model 143 by Gardiner Electronics Co., Phoenix, Ariz. Pitch of tone increases in proportion to radiation exceeding preset level.

Magnetometer (19)

Sharpe Model A-2 vertical force magnetometer is announced by Radiac Co. Inc., New York, N. Y., as especially designed for one-man operation. Scale divisions are 15 gamma with range to 15,000.

ALLIS-CHALMERS

Rotary COMPRESSORS



HOW *RO-FLO* UNITS OPERATE

Centrifugal force moves blades to outside wall to form air chamber.

You get MORE ADVANTAGES with *RO-FLO* units for shop air, drilling, gas handling

TYPE and SIZE for EVERY NEED

Both single and two-stage *Ro-Flo* compressors are available. Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm.

Two-stage units in twelve sizes for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage *Ro-Flo* vacuum pumps for vacuums to 0.3 inch mercury absolute, from 22 to 5950 cfm.

Call your nearest A-C office or write for bulletins 16B8244 (two stage) and 16B8126 (single stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

1. **CONSTANT EFFICIENCY** — During operation the sliding vanes of the rotor press against the cylinder wall to form air cells. Even if these vanes wear, the rotating force holds them in contact with the cylinder wall so that efficiency and air flow never change.
2. **LOW-COST FOUNDATIONS** — Smooth rotation cuts vibration. This eliminates need for heavy foundations used with reciprocating-type units. Small units can be bolted directly to the floor. Large units need only a simple slab.
3. **COMPACTNESS** — No extra weight or extra size is needed to dampen vibration. Every inch is devoted to air or gas handling.
4. **LOW MAINTENANCE** — There is no wear and tear from shock and vibration . . . no pistons and valves.

Ro-Flo is an Allis-Chalmers trademark.

A-5028

ALLIS-CHALMERS

How? Exclusive C & D Five-Fold Slyver-Clad plate insulation! Virtually eliminates shedding and sedimentation! You get more power per cubic inch of battery. You get more work for less cost! Specifically—

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Longer, heavier Slyver-Clad plates pack extra power.

EXTRA LIFE

Active material stays in plates—works longer!

All this in—

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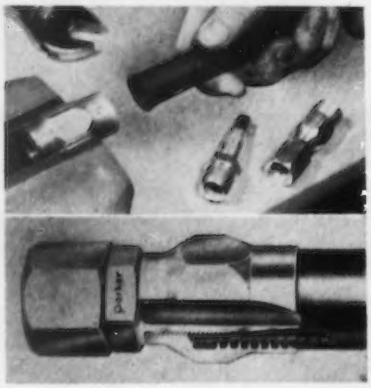
E&MJ NEW PRODUCTS DIGEST *(Continued)*



Hose Fitting (20)

No stripping of cover is needed with "no-skive" Hoze-lok line of fitting for rubber covered wire braid hydraulic hose. Designed for easier hose make-up, it is made by Parker Appliance Co., Cleveland, Ohio.

Air Cooling Unit (21)

Designed to reduce temperature in confined area, Breeze Wagon by Peuchen Engineering Corp., Wilmington, Del., removes up to 60,000 Btu per hr, moving up to 1,000 cfm, with electric power. It was designed for plant maintenance.

Rotary Compressor (22)

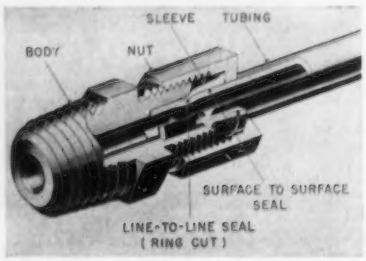
Gyro-Flo 900 is latest wagon-mounted rotary compressor in line offered by Ingersoll-Rand Co., New York, N. Y. Diesel driven, it delivers 900 cfm at 100 psi. Ready-to-go weight is 14,340 lb.

Rotary Compressor (23)

First model, rated at 600 cfm, of Airvane line of wagon-mounted rotary compressors is announced by Joy Mfg. Co., Pittsburgh, Pa. Several Joy-developed features reputedly boost efficiency.

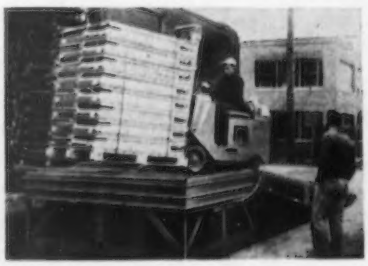
Blast Cleaning Unit (24)

Educt-O-Matic, all-position abrasive cleaning tool by Clementina Ltd., San Francisco, Calif., is "blast nozzle surrounded by vacuum cleaner." It is hooked to ½-in. air line. Abrasive recirculates.



Tube Fitting (25)

Selfalign tube fitting by Weatherhead Co., Ft. Wayne, Ind., is put on without disassembling. Tube is inserted and, as nut is tightened, sleeve and razor edge make tight seal. Low cost is claimed.



Loading Platform (26)

Magnesium cuts weight of this 8x8-ft loading dock to 772 lb. Leg height is adjustable. Portable set up by Magnesium Co. of America, E. Chicago, Ill., uses Yard Ramp and Dockboard accessories.

Drawing Board (27)

Space saving Foldaway drawing board tucks away in center drawer of desk or table. It comes complete with parallel rule from Arnot-Jamestown, New York, N. Y., in 15x20-in. and 21x26-in. sizes.

Recover more of these minerals with Armour amine reagents ...for as little as 7¢ per ton of ore!

Amblygonite
Spodumene
Ilmenite
Phosphate
Barite
Beryl
Cement Rock
Chromite
Feldspar
Fluorspar
Hematite
Kaolinite
Manganese
Mica
Potash
Salt
Scheelite
Silica
Syenite
Talc
Vermiculite

Armour cationic flotation reagents produce the fastest attachments to minerals known—selectively float more concentrate in less time, at less cost!

Increased recoveries of minerals listed here—plus greater throughput—are economically achieved with Armour flotation reagents. That's because the coating reaction between an Armour flotation reagent and the *specific* mineral you want is *instantaneous!* Armour-treated minerals then attach to rising air bubbles quickly, firmly.

You use less equipment too, because the sharp selectivity of Armour cationic flotation reagents enable you to recover minerals without using an extra cleaner flotation step. You can float minerals from one ton of ore for as little as 7¢!

Armour—first to develop the use of cationic chemicals in flotation—continues to lead the way toward improved methods of applying these chemicals. Results of broad Armour research and experience are now available in a new 20-page booklet detailing the characteristics and advantages of cationic chemicals in flotation. Send coupon for informative booklet today!

ARMOUR CHEMICAL DIVISION

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Leading Specialists in Flotation Chemicals

NOW AVAILABLE FOR THE FIRST TIME!
New Booklet, "Mineral Flotation with Armour Cationic Chemicals."

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City_____ State_____

E5

Mixer **(28)►**

Cleveland Mixer Co., Bedford, Ohio, offers K-Series top entering mixer with paddle or turbine agitator. Among features claimed are ruggedness, simplicity, and easily varied speed.

◄ Gas Indicator **(29)**

Change in resistance of platinum filament due to heat of oxidation, measures combustibles in air sample sucked into flashlight-battery-powered device of Mine Safety Appliances Co., Pittsburgh, Pa.

Protective Coating **(30)**

Adhesion of paint to the smoothest surfaces is assured when Totrust Metal-Bond, a clear brush- or spray-on protective coating, is used for undercoat, says Wilbur & Williams Co., Boston, Mass.

Protective Coating **(31)**

Aluminum reacts with solution of Turcoat 4178, dry chemical, to give flexible surface film that has better corrosion resistance and paint adhesion, says Turco Products Inc., Los Angeles, Calif.

Centrifugal Pumps **(32)**

Dean Bros. Pumps Inc., Indianapolis, Ind., says GS series is an inexpensive line of seven standardized centrifugal pumps featuring simple design and interchangeable parts, sized 1x2 to 3x4 in.

Well Pumps **(33)**

Verti-Line Package-Pumps, for wells down to 4 in. in diameter, by Layne & Bowler Pump Co., Los Angeles, Calif., are turbine type with capacities from 200 to 7,500 gph at heads to 340 ft.

Recording Instrument **(34)**

First rectilinear recording milliammeter is claim made by Texas Instruments Inc., Dallas, Tex., for their portable device which uses a special pantographic linkage. Among features cited are economical price, enclosed inking system, compact and lightweight.

Electrical Wire **(35)**

Electrically insulating aluminum wire by giving it a thin ductile oxide surface through a process of anodizing with alternating current and drawing through chemical solution, is announced by Aluminum Co. of Canada, Montreal, Can. It is said to open new design horizons.

Mathematical Charts **(36)**

Calculine, mathematical charts, are used for same purpose as slide rule or calculating machine. Frederick Post Co., Chicago, Ill., says 8½x11-in. cards are inexpensive, use no straight edge, leave hand free, and can be placed in field notebook or under desk glass.

Electric Motors **(37)**

For general use, ¼ to 40 hp Synduction motors are simple in design, have advantages over existing synchronous reluctance types and approach efficiency and P.F. of squirrel-cage units, says Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Electric Motors **(38)**

Rectangular shaped small fractional horsepower dc motors, that save space over round motors of same output, have been developed by Leece-Neville Co., Cleveland, Ohio, according to release. Flux path is said to be axial not concentric.

Electric Motors **(39)**

Variable speed ac drive motors, called Selectron, are now produced by Electro Dynamic Div., General Dynamics Corp., Bayonne, N. J. Speed range, normally 22 to 1, can be as great as 60 to 1, says announcement citing features of the drive designed for general industrial use.

Pipe Patcher **(40)**

Atlas Industries Inc., Houston, Tex., says this Pipe-Tool repairs leaks economically, quickly and permanently. Either rod or chain-type clamp holds gasketed steel patch, bought in specific pipe size, in place until welded or cemented.

Mobile Radio **(41)**

Compact, rugged IMP (Industrial Mobile Phone) radio operates off 6 or 12v dc or 117v ac as base station, mobile transceiver or mobile p.a. system according to Karr Engineering Corp., Palo Alto, Calif. Range is one to five miles.

Safety Hat & Goggle **(42)**

Combination of hard hat and goggles is perfectly balanced in Supergard, says Boyer-Campbell Co., Detroit, Mich. Goggles, on hinged bracket, can be worn over personal glasses. Dark lens is for welding. Side shield protects from chips.

Filter Felt **(43)**

Brosites Products Corp., New York, N. Y., says one advantage of acid resistant filter felt of Dacron is easy-to-clean slick finish. Nylon is also used in their Filtaweb line of synthetic filter felts.

Filter Bags **(44)**

Dacron cloth is now used for after-filter bags on cyclone type dust collector from Torit Mfg. Co., St. Paul, Minn. They are claimed non-shrinking when washed, mildew-proof, and spark-proof.

Filter Felt **(45)**

Openings in special woven Orlon fabric are packed with short Orlon fibers to give a filter felt with high chemical, temperature and bursting resistance, says Filtration Engineers Inc., Newark, N. J.

BIRDIE... thanks to brick!

And impossible *without* brick. You would have no rubber for the ball... no steel for the clubs. You would have no mower to trim the fairways and clip the greens. And no clubhouse.

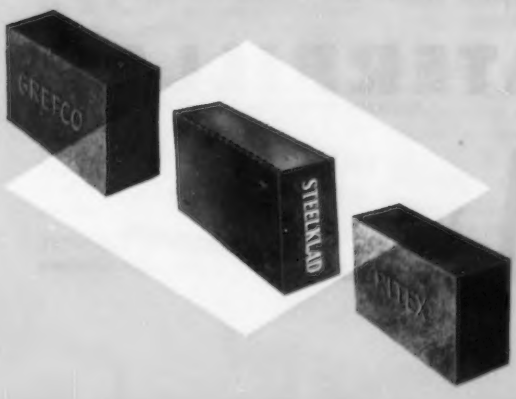
Everything made... everything that moves... owes its very existence to refractory brick... refractory brick that contains and controls the many flames of industry. Brick in infinite variety of shape and composition. There could be no industry were it not for brick.

And General Refractories, to provide the complete refractory service that industry needs, employs the world's largest, most-modern refractories research laboratory and 66 mines and manufacturing plants both here and abroad.

A Complete Refractories Service
GENERAL REFRACTORIES COMPANY
Philadelphia 2

A COMPLETE REFRACTORIES SERVICE FOR THE COPPER INDUSTRY

Three types of basic brick—RITEX, GREFCO, STEELKLAD for the three basic processes—smelting, converting and refining. Each type of brick available in the ranges of composition—Magnesite, Magnesite-Chrome, Chrome-Magnesite and Chrome—required to adapt to variations in metallurgical processing.



RITEX—chemically bonded for low cost, superior workmanship, resistance to spalling, ready availability.

GREFCO—conventional type bonded by tunnel kiln high temperature firing, for maximum strength and hardness.

STEELKLAD—steel encased on two, three or four sides and for special jobs, steel plates incorporated in the brick interior as well—for maximum resistance to spalling in the most severely treated exposed walls.

RITEX, GREFCO and STEELKLAD—each the result of many years of intimate knowledge of the copper industry and careful study of service conditions, each prepared from the best available raw materials and made with the most modern manufacturing facilities—all within easy access to your operation.

GENERAL REFRACTORIES

Seminole Rock Products of Miami, Fla., bought five CAT* DW15s with W15 Wagons on the basis of its previous experience with Caterpillar products. Dragline loaded with lime and coral rock, these units make a 1650-ft. haul (with short 10% adverse grade) over excellently maintained roads to the processing plant, and 2000-ft. return. After the Caterpillar DW15s had been on the job long enough to show what they could do, here is what General Manager L. G. Bunnell had to say:

"These DW15s have power to spare. With an average load of 15.2 yd. (45,600 lb. actual weight), haul and return time is only 4.09 minutes. The five units haul 358 cu. yd. per hour—estimated hauling cost is only 9.2¢ per yard. Thanks to their powerful Cat Engines, the DW15s started up from the dragline in second gear, high range.

"We are particularly satisfied with their extreme economy. In more than 1600 hours of combined operation, these five new Caterpillar DW15s have had no down time. Their rugged construction and trouble-free operation are important factors in cutting costs. Important, too, are their ease of maintenance and their ability to deliver full, foul-free power on No. 2 furnace oil.

"We like the high maneuverability of the Cat DW15 and W15 Wagon," Mr. Bunnell concludes. "This, with their dependability and power, speeds up our operation considerably."

Your Caterpillar Dealer—who provides skilled service and factory parts you can trust—will demonstrate the DW15 on *your* job. Give him a call soon.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

AC Power Pack (46)

Carried on shoulder strap, small, 9½-lb power pack DY-1012 by Dynaseal Lighting Corp., Cambridge, Mass., will deliver 50 watts of 115v, 60-cycle ac for 50 min before built-in battery charger need be used. It can be stored indefinitely and sealed battery needs no maintenance, they say. Unit is designed for general purpose use.

Tarpaulin Fabric (47)

Nylon and special plastic are combined in protective fabric that is claimed tearproof, 10 times stronger than canvas yet easily handled. Herculite Protective Fabrics Inc., Belleville, N. J., is maker.

Pneumatic Tires (48)

For off-the-road use on heavy service equipment, Super Fleetmaster tires have tread design that virtually ends groove cracking, cuts side slippage and ejects stones, says U. S. Rubber Co., New York, N. Y. Among other features cited are: non-directional lugs, cooler running, and uniform wearing.

Spot Welding Gun (49)

To simplify and speed sheet metal fabrication, spot arc welding gun is offered by Spot Arc Gun Sales Co., Cleveland, Ohio. Plastic body makes it lightweight and shockproof. It is used with 150+ amp, ac or dc welder.

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card below and mail.

METALLIZING applications and methods are covered in bi-monthly *Metco News* of Metallizing Engineering Co. Inc., Westbury, N. Y. No. 12 tells of fighting corrosion with zinc, repairing pump casing with stainless steel, and some hardfacing applications. **(50)**

MOLYBDENUM chemicals usage, properties and other data are given in literature issued by Climax Molybdenum Co., New York, N. Y. Descriptive index is offered. **(51)**

SIGNALS, visual and audible, for all industries are summarized in an attractive and comprehensive bulletin titled "How to Select Signals" published by Federal Sign & Signal Corp., Chicago, Ill. **(52)**

FASTENING applications of Ramset stud driver on plant maintenance and construction are described in booklet from Olin Mathieson Chemical Corp., Cleveland, Ohio. Some are fastening conduits, ducts, fixtures and partitions to steel, concrete, etc. **(53)**

TIMBER DESIGN examples, particularly trusses using Teco wedge-fit connectors, as well as other plans for variety of structures, are shown in this year's "Typical Lumber Designs" by Timber Engineering Co., Washington, D. C. **(54)**

ELECTRIC PLANTS powered by internal combustion engines are covered in an 8-page manual from International Fermont Machinery Co. Inc., Ramapo, N. Y. Section on selection factors gives some good basic information. **(55)**

TUNNEL & MINE EQUIPMENT available from Mayo Tunnel & Mine Equipment, Lancaster, Pa., is shown in 8-page catalog. Illustration captions give use and application. **(56)**

TC BITS & TOOLS by Mining Tool Div., Kennametal Inc., Bedford, Pa., are catalogued in booklet. Drawings give nomenclature and design features, while tables and descriptive paragraphs give other data for drilling and cutting hardest to softest rock. **(57)**

CONCRETE GUNNING EQUIPMENT is shown in catalog from Air Placement Equipment Co., Kansas City, Mo. Complete line, applications and fundamentals are given. **(58)**

BULK MATERIAL HANDLING equipment—for rock, gravel, coal, etc. —is described in two catalogs issued by McNally Pittsburg Mfg. Corp., Pittsburg, Kan. Conveyors, feeders, elevators, et al are detailed. **(59)**

CENTRIFUGAL PUMPS & VALVES by McNally Pittsburg Mfg. Corp., Pittsburg, Kan., are described in technical catalog-bulletin. **(60)**

HEAT TRANSFER APPARATUS for cooling and condensing process fluids are shown in catalog on sections made by National U. S. Radiator Corp., New York, N. Y. Considerable space is devoted to design fundamentals. **(61)**

HEATERS & HEATING DEVICES of almost every conceivable type can be electrified and the 60-page catalog issued by General Electric Co., Schenectady, N. Y., indicates they have done it. **(62)**

THERMAL INSULATIONS and refractories available from Johns-Manville, New York, N. Y., are a really complete line, controlling tempera-

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E&MJ NEW PRODUCTS DIGEST *(Continued)*

tures from 400 F below zero to 3,000 above. Catalog is available. **(63)**

HOISTING EQUIPMENT — light duty gasoline-fueled mine shaft hoists and an ingenious skip-cage—are shown on data sheet from Vulcan Iron Works Co., Denver, Colo. Both meet safety laws, it is said. **(64)**

PIPE made of Transite for mine service is advantageous in corrosive situations. Ring-Tite couplings with rubber sealing rings make quick job. Both are described in bulletin from Johns-Manville, N. Y., N. Y. **(65)**

ROLL CRUSHERS double roll type, are covered in bulletin from McLanahan & Stone Corp., Holidaysburg, Pa. They are for finer reduction of medium size feeds. Information on calculating capacity is included. **(66)**

VIBRATING SCREENS, Telsmith brand, are described in bulletin from Smith Engineering Works, Milwaukee, Wis. Complete line for scalping, sizing and finishing is illustrated with typical applications. **(67)**

VIBRATING SCREEN, Model S Ripl-Flo, by Allis-Chalmers Mfg. Co., Milwaukee, Wis., is subject of bulletin just issued. Selection procedure for single and multiple setups to handle up to 4-in. material is given. **(68)**

SCREENING needs of wide variety are met with standard or custom-made Wissco-loy Space screens by Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., N. Y., N. Y. Illustrated booklet gives details. **(69)**

REFRACTORIES and heat resisting coatings of the M. W. Kellogg Co., N. Y., N. Y., are described in several data sheets. One is on Krome Ram, plastic chrome ore; others are on black and aluminum coatings. **(70)**

METAL CLEANERS for preparing metallic surfaces for various treatments are dealt with in brochure from Hanson-Van Winkle-Munning Co., Matawan, N. J. Tables give applications for each Matawan cleaner. **(71)**

RADIOISOTOPE catalog issued by Oak Ridge National Laboratory is available from Union Carbide Nuclear Co., Oak Ridge, Tenn. Nearly 100 compounds are described and priced. General information on use is included. **(72)**

SILICONE products of all sorts are included in illustrated 1956 Reference Guide published by Dow Corning Corp., Midland, Mich. Concise, meaty text gives reference for more detailed data as well. **(73)**

STRUCTURAL MATERIALS of polyethylene and polyvinyl chloride as well as equipment for fabrication are detailed in catalog from American Agile Corp., Maple Heights, Ohio. **(74)**

FLUOROCARBON RUBBER, Kel-F Elastomer by M. W. Kellogg Co., Jersey City, N. J., has some amazing chemical-resistant properties. These and other specifications and applications are presented in booklet. **(75)**

PROTECTIVE COATINGS — INDUSTRIAL ADHESIVES is topic of catalog giving technical details of Magic-Vulc products offered by Magic Chemical Co., Brockton, Mass. **(76)**

RUST PREVENTIVE PRODUCTS made by Rust-Oleum Corp., Evanston, Ill., are covered in general catalog. Details on use and color chips for each compound are given in the well illustrated booklet. **(77)**

SCREW FASTENING with Speed Nuts can solve problems in an amazingly large number of situations. Story on self-locking, spring tension device is given in booklet from Tinnerman Products, Inc., Cleveland, Ohio. **(78)**

TIMBER CONNECTORS as well as other products and services of Timber Engineering Co., Washington, D. C. are shown in latest catalog. **(79)**

X-RAY image intensifier for fluoroscopic examination of structural steel and certain other metals is described in bulletin from North American Phillips Co., Inc., Mt. Vernon, N. Y., Research & Control Division. **(80)**

SHELVING of Klip-Bilt boltless steel-type is subject of illustrated catalog released by Frick-Gallagher Manufacturing Co., Wellston, Ohio. Standard and special parts and accessories are described. **(81)**

FAN CLUTCHES are rather thoroughly analyzed in a technical report issued by Warner Electric Brake & Clutch Co., Beloit, Wis. Applied to internal combustion engines, the electrically controlled units are said to cut fuel consumption, increase power, speed warm up and give quieter operation as well as having other advantages. **(82)**

LUBRICANT called Primaleen, manufactured by Protecto-Lube Co., Detroit, Mich., is described as an all-purpose agent in brochure available. Contracting and mining machinery is stated as a particular application. **(83)**

PHOTOGRAPHY "in-plant" can cut costs in a number of ways according to booklet from Graflex Inc., Rochester, N. Y. Case histories are given and illustrated. **(84)**

VERTICAL PUMP MOTORS made by U. S. Electrical Motors Inc., Los Angeles, Calif., are reviewed in brochure. Attractive in full color, it contains a host of technical data, descriptions of features and applications. **(85)**

CHEMICAL PROCESS equipment from Brosites Machine Co., Inc., New York, N. Y., is covered in several bulletins. Continuous dialysers, which separate solution components and filter presses, are shown for lab, pilot plant and production. **(86)**

Run one end of the Quarrycord out to a place where it can be lighted easily. When everything is in readiness, light the Quarrycord with a match and *walk* away.

(PLEASE GIVE THIS ADVERTISEMENT TO YOUR BLASTING FOREMAN)

Quarrycord

for one-shot lighting of safety fuse in secondary blasting

Now you can ignite each and every safety fuse from *one point*, and eliminate the hazard of men climbing over the rock pile, lighting each fuse individually.

Now you can have the advantage of fuse blasting, so that the holes go "pop-pop-pop" rather than "BOOM" — to reduce the noise of a single blast.

Now you can fire when convenient, without fear of stray electrical currents causing premature blasts.

Quarrycord is a flexible, water-resistant cord which burns with an external flame at the rate of about one foot per second.

It is very easy to use: (1) Prepare each primer cartridge in the usual way with safety fuse and detonating cap. (2) On the end of the fuse opposite the cap place a Quarrycord Connector. (3) Load and tamp the holes. (4) When ready to blast, run a line of Quarrycord so as to connect with each hole (5) At each fuse, pass the Quarrycord into the slot in the end of the connector and press the "lid" down *tight* over it to make positive contact (6) If your hook-up has parallel lines of Quarrycord, make frequent cross connections as shown.

Quarrycord is packed on spools in 500 foot lengths, two spools to a box. Connectors are supplied in cardboard boxes containing 100 each.

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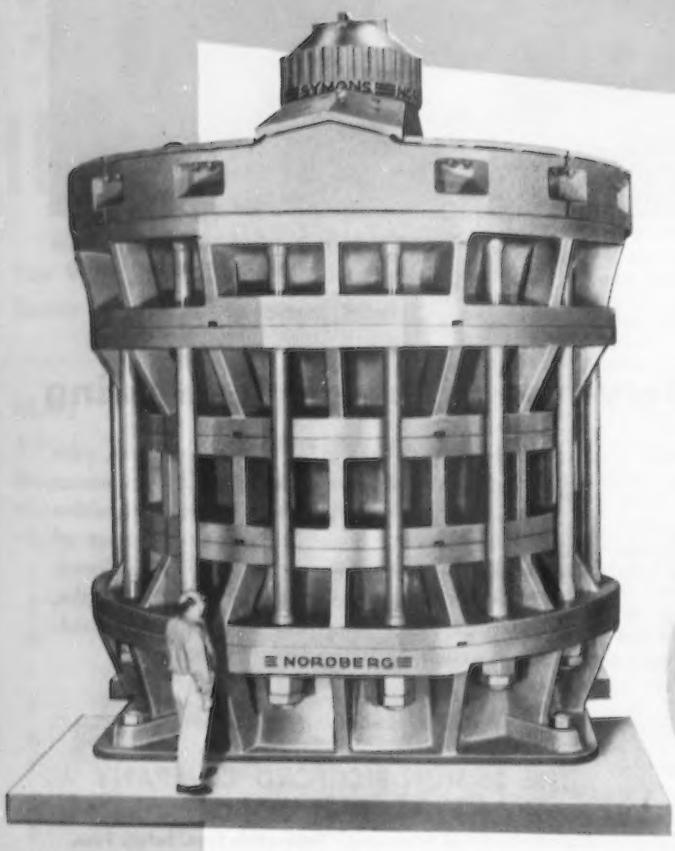

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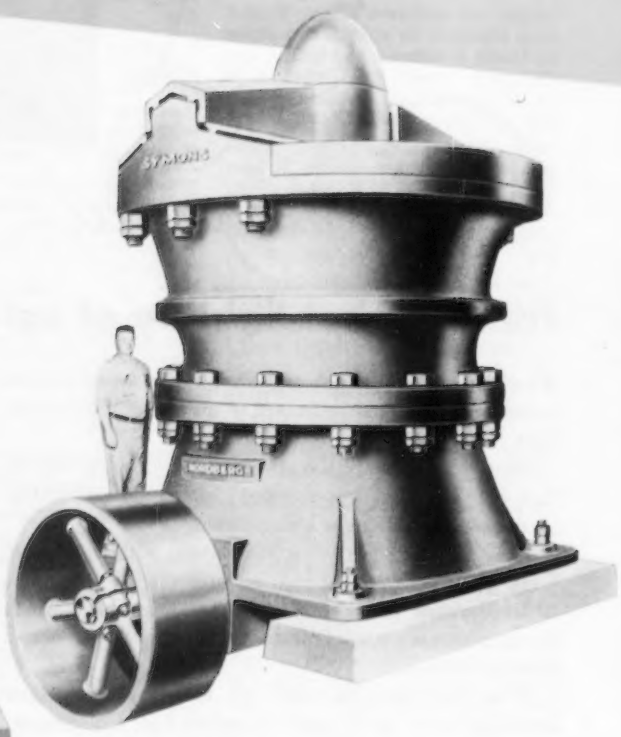

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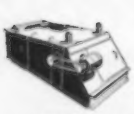

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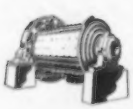

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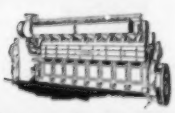

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All over the world, for big tonnage requirements and heavy duty crushing operations, Symons Gyratory and Cone Crushers are the outstanding choice of the mining and quarrying industries . . . because they *assure maximum and continuous production at low operating and maintenance costs.* For heavy duty primary breaking, Symons Gyratory Crushers are available in 30″, 42″, 54″, 60″ and 72″ sizes, for capacities up to 3500 and more tons per hour. For secondary and finer reductions, Symons Cone Crushers, in both Standard and Short Head types, are available in sizes ranging from 22″ to 7′—in capacities from 6 to 900 or more tons per hour.

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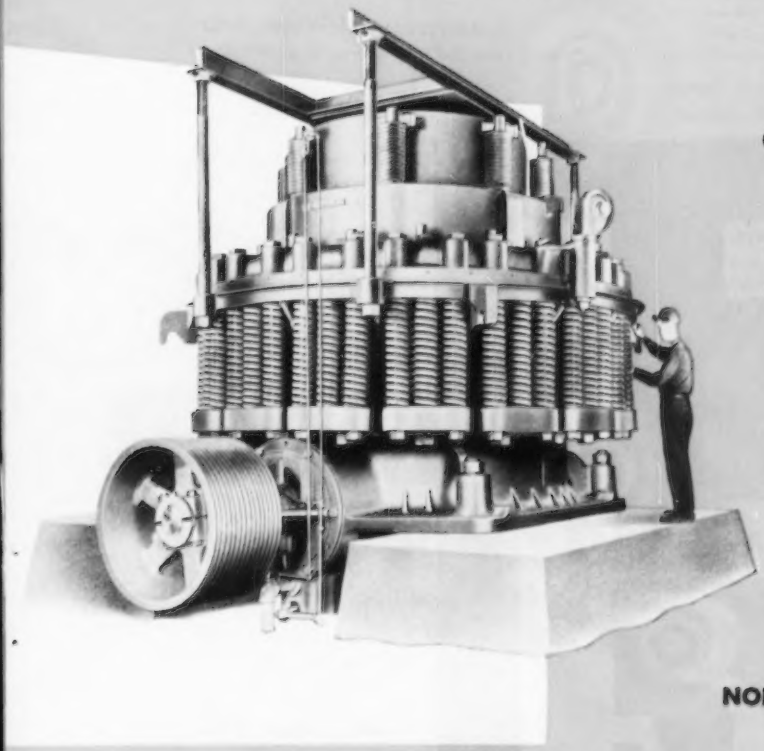

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CF&I Claymont, Delaware

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Poultry Netting—Hex Mesh Nettings—Hardware Cloth—Industrial Wire Cloth—Alloy Processing Belts—Perforated Metals—Overhead Conveying Equipment—Sliding Door (Industrial) Hardware.

CF&I Mt. Wolf, Pennsylvania

Insect Wire Screening and Industrial Wire Cloth.

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Fish and Crab Trap Netting—Stucco Netting—Poultry Netting—Hardware Cloth—Industrial Wire Cloth—Straightened and Cut Wire—Reinforcing Tie Wire—Mechanic's Wire—Chain Link Fence—Crimped Wire.

CF&I Palmer, Mass.

Wire Rope—Wire Rope Slings—Wire, all types (see Buffalo Plant)—Wire Clothesline—TV Guy Wire—Aircraft Control Cable.

CF&I Pueblo, Colo.

Bar, Rod and Structural Products—Grader Blades and Cutting Edges—Rails and Accessories—Chain Link Fence—Woven Wire Fence—Fence Stays—Fence Posts—Corn Cribs—Welded Wire Fabric—Nettings—Grinding Balls and Rods—Screen and Grizzly Bars—Rock Bolts—Galvanized Strand—Clothesline—Barbed Wire—Manufacturer's Wire (Basic, Chain, Spring, Stapling, Weaving, Welding)—Merchant Wire (Annealed and Galvanized)—Nails—Bolts—Nuts—Spikes—Seamless Casing and Tubing.

CF&I Roebling, N. J.

High Carbon Steel Wire (Hard Drawn, Spheroidized and Tempered)—Rope Wire—Tire Bead—Hose Wire—ACSR Core Wire—High Carbon Spring Steel Wire (All grades, tempers and finishes)—Regulator, Sash Balance and Flapper Valve Wire.

CF&I Roebling (Trenton), N. J.

High and Low Carbon Flat Wire (All tempers, edges and finishes)—Brush, Corset, Casing, Heddle and Drop Wire, Umbrella Wire and Tape Lines—Wire Rope—Strand, Aircord and Fittings—Wire Rope Slings—Electrical Wire and Cable and Magnet Wire.

CF&I So. San Francisco, Calif.

Galvanized and Annealed Merchant Wire—Galvanized and Annealed Stone Wire—Bale Ties—Baling Wire—High and Low Carbon Wire—Galvanized and Annealed Wire—Copper Coated Wire—Rope Wire—Welding Wire.

CF&I Worcester, Mass.

Valve and Clutch Springs—Starter Springs—Tire Chain Adjusters—Cross Chain Repair Links—Mechanic's Wire—Compression, Extension and Torsion Springs of all types—Formed Wires.

STEEL PRODUCTS

CF&I STEEL PRODUCING PLANTS

CF&I Pueblo, Colorado

Blast Furnaces and Open Hearths producing pig iron, ingots, blooms, billets and rods.

CF&I Buffalo, New York

Blast Furnaces and Open Hearths producing pig iron, ingots, blooms, billets and rods.

CF&I Claymont, Delaware

Open Hearths producing ingots and steel plate.

CF&I Roebling, New Jersey

Open Hearths producing ingots, blooms, billets, and rods.

CF&I Brooke, Pennsylvania

Blast Furnaces producing basic, Bessemer, foundry, malleable and low phosphorus pig iron.

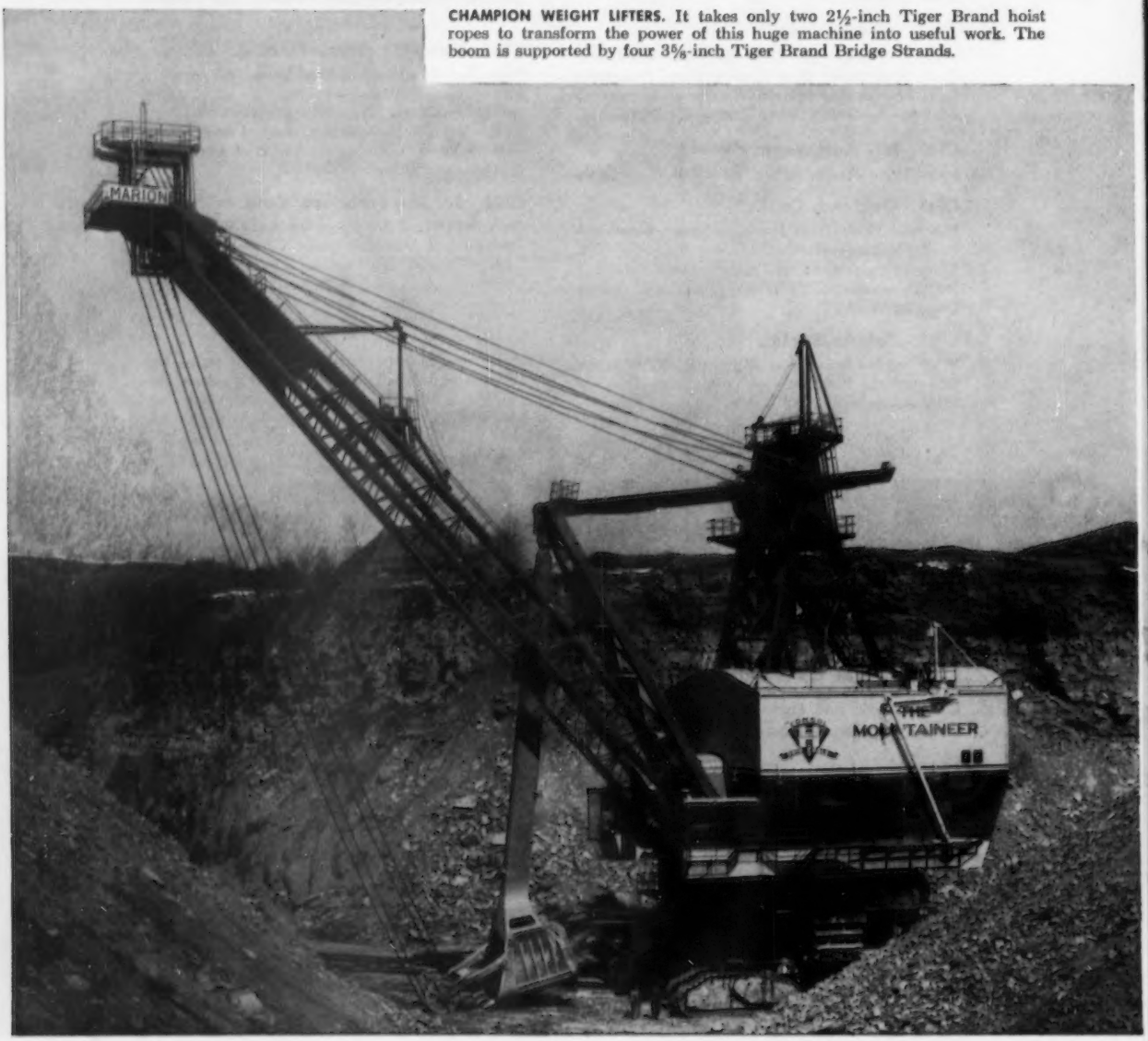
3491

This shovel is so

It scoops up 90 tons of overburden in one bite

THE MOUNTAINEER, "world's largest shovel," built by Marion Power Shovel Company for Hanna Coal Company Division of Pittsburgh Consolidation Coal Company.

CHAMPION WEIGHT LIFTERS. It takes only two 2½-inch Tiger Brand hoist ropes to transform the power of this huge machine into useful work. The boom is supported by four 3⅝-inch Tiger Brand Bridge Strands.



big you can't believe your eyes

THE BIG DIPPER can scoop up 60 cubic yards of overburden, deposit it 290 feet away in piles 100 feet high. Tiger Brand Wire Rope provides the steel "muscles" that make it work.

You have to look at this shovel with your imagination—for your eyes will surely deceive you. The tip of the boom, for example, rises up as high as a 16-story building. The shovel has the power to lift a platform containing 166 1½-ton automobiles 100 feet into the air, swing them the length of a football field, set them down on top of a 10-story building, and swing back for another load . . . all this in 45 seconds!

The tremendous power of the shovel is transmitted to the dipper through two 2½-inch American Tiger Brand Wire Ropes, each 580 feet long. The huge boom, which towers 160 feet, is supported by four 115-foot lengths of 3⅝-inch diameter Tiger Brand Galvanized Bridge Strand. Each strand has a breaking strength of approximately 800 tons, for a total of 3200 tons.

In addition to the main hoist ropes and boom supports, the three-man elevator shuttles up and down on standard Tiger Brand Elevator Wire Rope.

The fact that all of the wire rope applications on this "world's largest shovel" are being handled by standard Tiger Brand constructions emphasizes the quality of the engineering that goes into the complete line of Tiger Brand Wire Rope. No matter how big and exacting the job, you can get a Tiger Brand Rope to fit your needs.

AMERICAN STEEL & WIRE
DIVISION
UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN TIGER BRAND WIRE ROPE

USS *Excellay Preformed*

UNITED STATES STEEL

Gardner-Denver . . . Serving the World's Basic Industries

Push production...protect personnel... with Gardner-Denver Mine Car Loaders

For the job: Powerful crowding action—utilizing both 5-cylinder air motors—fills the dipper in any muck pile. Fast discharge loads long mine cars to brim. Wide clean-up.

For the man: Easy-to-reach, easy-to-work controls. No clothes snagging gadgets on the outside. Rail-hugging stability, due to low center of gravity and high-flange wheels.

Send for information.

GARDNER - DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

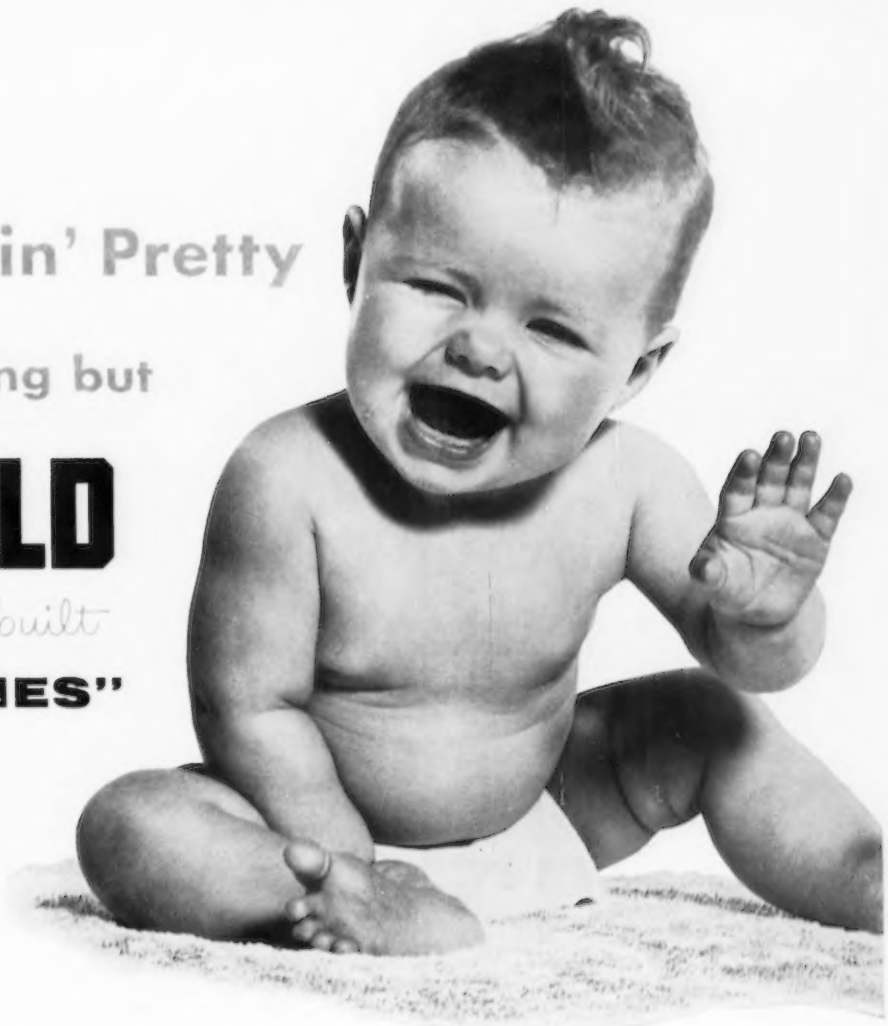
"I'm Sittin' Pretty

use nothing but

GOULD

Research-built

BATTERIES"



America's Finest!
GOULD
Shuttle Car and
Locomotive Batteries

There are three big reasons why it pays to choose Gould Research-Built Batteries:

1. They are the finest batteries modern science can give you—research-built for longest service life.
2. Strategically located Gould plants assure prompt attention to your battery requirements.
3. Gould Field Engineering Service, finest in the industry, nation-wide in scope, is as close to you as your telephone, always ready to see that your batteries are properly cared for and maintained . . . that you get maximum battery performance.

The MATERIAL HANDLING INSTITUTE'S EXPOSITION
Cleveland, Ohio
PUBLIC AUDITORIUM
JUNE 5th THRU 8th
1956
mhi
EXHIBITOR
Booth 1425

Always Use Gould-National Automobile and Truck Batteries

GOULD
BATTERIES
GOULD-NATIONAL BATTERIES, INC.
Trenton 7, N. J.

"BETTER BATTERIES THROUGH RESEARCH"

©1956 Gould-National Batteries, Inc.

AERO® Brand Cyanide Available *from Basic Integrated Production*

Cyanamid customers are assured of an unfailing supply of AERO Brand Cyanide to cover their complete needs. Basic, integrated cyanide production in both hemispheres doubly assures continuance of our performance record: "Through two World Wars no Cyanamid customer has ever had to curtail or shut down mill operations for lack of AERO® Brand Cyanide".

Equally important, AERO Brand Cyanide has inherent advantages that make it an excellent money-value:

On the basis of contained NaCN equivalent, the metallurgical efficiency of AERO Brand Cyanide equals that of any other grade.

AERO Brand Cyanide has an inherent protective alkali content which usually reduces lime requirements.

AERO Brand Cyanide is clean, easy to handle and has been used for years with perfect satisfaction by small and large mills alike.

North American Cyanamid Limited.

South African Cyanamid (Pty.) Limited.

on Two Continents

Our Field Engineers are always available to assist on metallurgical problems. They bring you the combined experience of a mature world-wide technical staff and the research resources of Cyanamid's Mineral Dressing Laboratory.

To further assist AERO Brand Cyanide users we have recently issued

Mineral Dressing Notes No. 22

HANDLING AND FEEDING OF AERO® BRAND CYANIDE

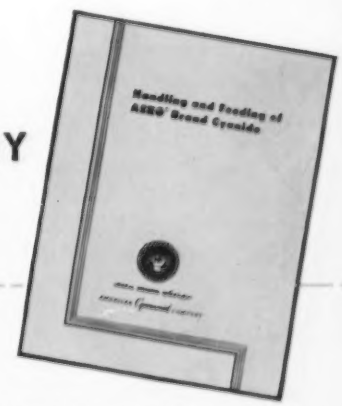
This 16-page manual contains a wealth of practical suggestions and diagrams of feeder arrangements for both small and large mills. A copy will be sent with our compliments.

CYANAMID

AMERICAN CYANAMID COMPANY

MINERAL DRESSING DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK



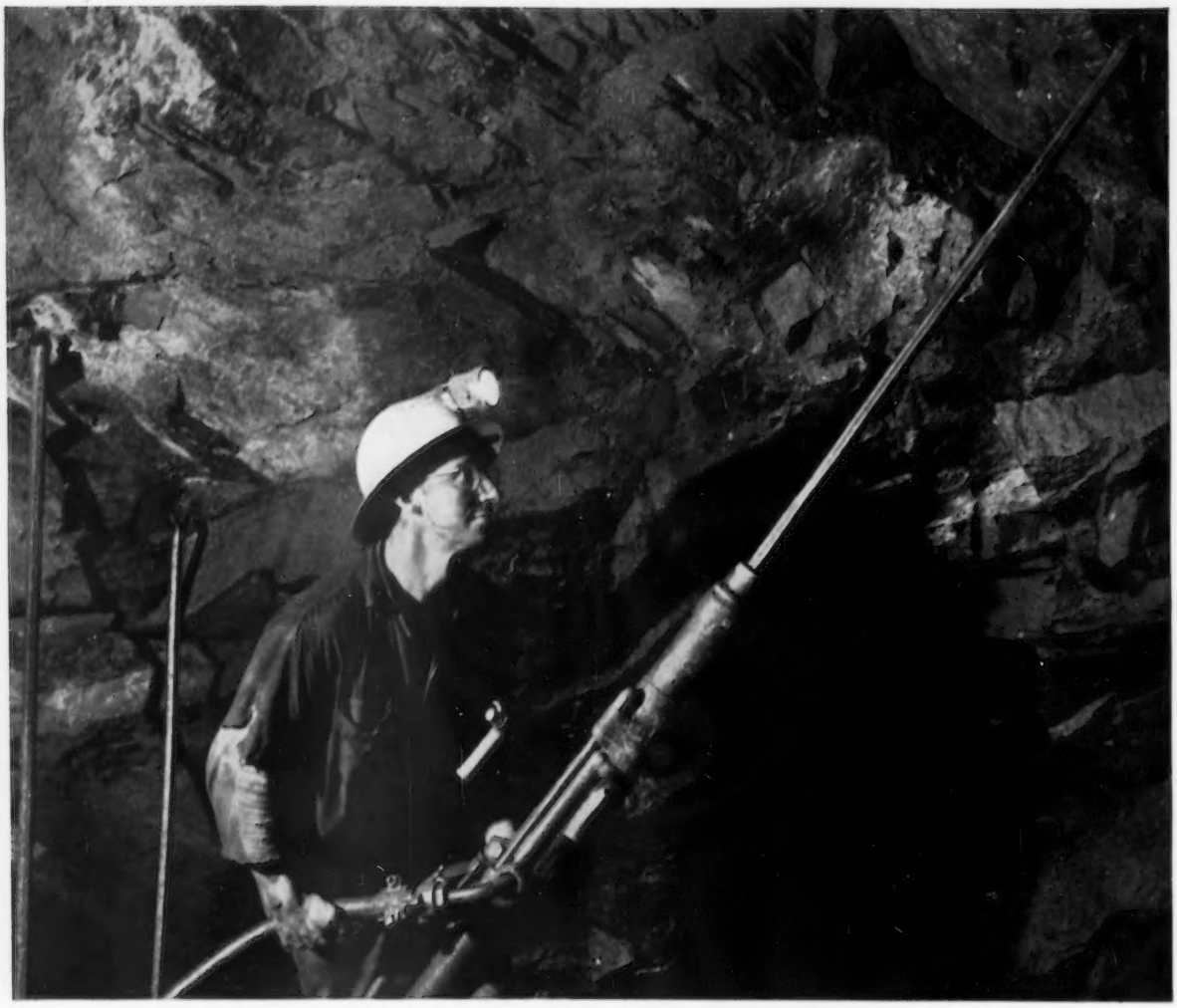
American Cyanamid Company
30 Rockefeller Plaza
New York 20, N. Y.

Kindly send me _____ copies of Mineral Dressing Notes #22 — HANDLING AND FEEDING OF AERO® BRAND CYANIDE

Name: _____

Company: _____

Address: _____



They're Drilling Hard Rock at the Richard Ore Mine

There's some interesting hard-rock drilling going on these days at the Richard Ore Mine of The Colorado Fuel and Iron Corporation. This iron-ore mine, located in gently rolling country at Wharton, N. J., has abundant deposits of magnetite, gneiss and granite—tough going for drilling crews.

To make effective headway against these types of rock, a large proportion of the blast holes are being drilled with Bethlehem Hollow Drill Steel. The Bethlehem Hollow, in 1-in. hexagons and 1¼-in. rounds, is fitted with carbide-insert bits, and is used in jackhammers, stopers and jumbos. In general, blast holes are 6 ft or 8 ft deep. Reconditioning is done top-side, in the mine's own shop.

For any type of hard-rock drilling, you can count on minimum breakage with Bethlehem Hollow. This is because it is rolled from a tough grade of fatigue-resisting steel. Its wide quenching range makes it easy to heat-treat for the proper balance of toughness and wear-resistance, while providing long-wearing threads and tough shanks.

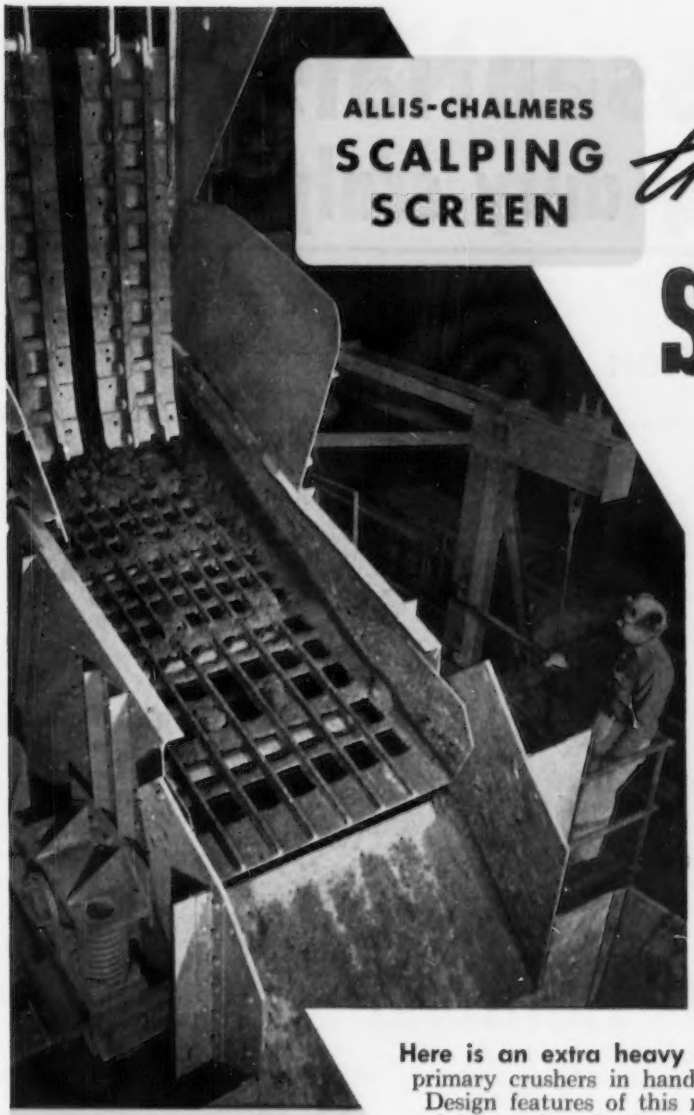
Bethlehem Hollow is good, hard-working drill steel. It comes in carbon and ultra-alloy grades in rounds, hexagons and quarter-octagons, and in popular lengths of from 18 ft to 25 ft. Longer lengths can be supplied for special requirements.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL CARBON AND ULTRA-ALLOY

BETHLEHEM STEEL



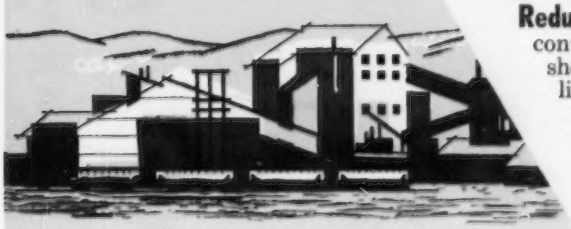
ALLIS-CHALMERS
SCALPING
SCREEN

the BIG SCREEN for the BIG JOBS

- **Extra-Large Mechanism**
- **12-inch I-Beam Deck Support**
- **Takes Punishing Loads**

Here is an extra heavy duty screen engineered to team up with primary crushers in handling the toughest job in any mining flow. Design features of this rugged screen include a cartridge-type, oil-lubricated mechanism with giant size bearings and a 12-inch I-beam in channel-constructed top deck support frame. The bearings, largest ever installed in a vibrating screen, are designed for long term service under heavy load conditions. The sturdy channel construction of the screen deck support frame can withstand the impact of single pieces weighing as much as 8000 pounds.

Performance proved on the *Mesabi* range . . . one of the toughest testing grounds in the world.



Reduced Maintenance — Simplified two-bearing, cartridge-contained mechanism can be pulled out after removing sheave and four bolts. Large size bearings mean extended life, less frequent replacement.

Vibration Isolation — Standard design includes multi-unit vibration isolators — two per corner, each with an inner and outer spring arrangement. Vibration to building or structure is isolated even when materials adhere to screen.

A-5051

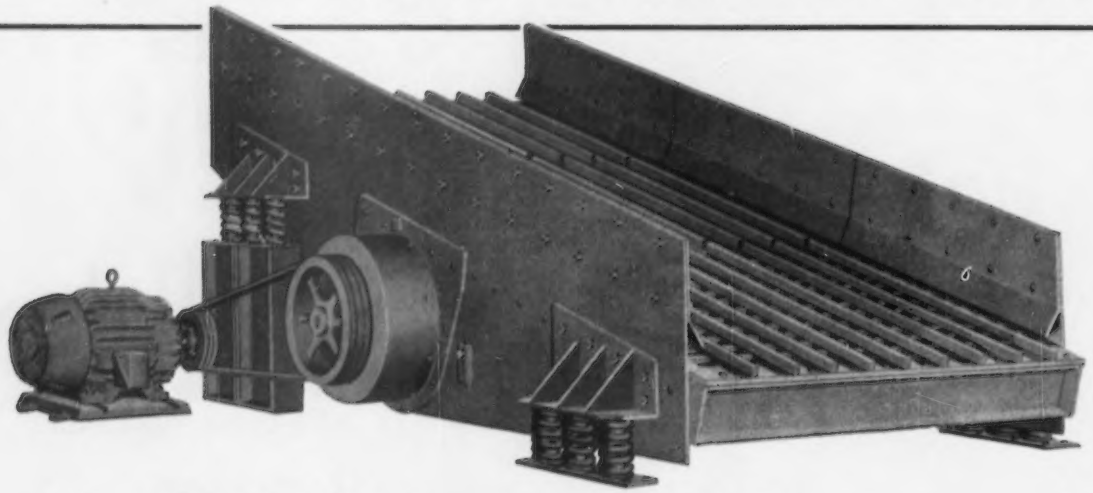
For complete information, see your A-C representative or write for Bulletin 07B8368. Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

4 essentials
for heavy duty scalping

1. GREAT STRENGTH **2. HIGH CAPACITY**

3. EFFECTIVE SEPARATION **4. TROUBLE-FREE OPERATION**



You'll find them all in this proved LINK-BELT Vibrating Screen

ON every count, Link-Belt Scalping Screens offer the capacity, efficiency and stamina you need for heavy run-of-pit applications.

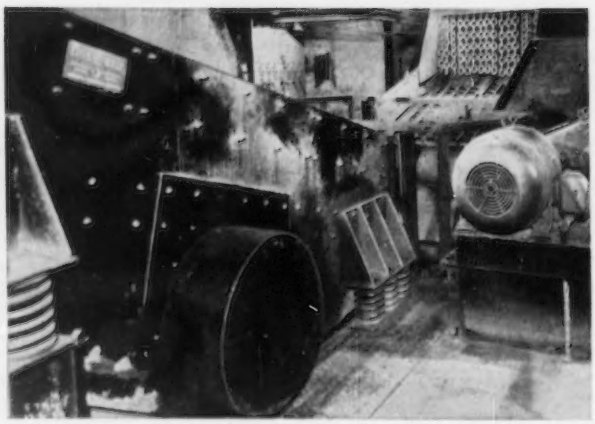
(1) MASSIVE FRAME utilizes heavy-section ship channels and H-beam members. Welded deck is securely riveted to thick side plates. Rugged stress-relieved frame easily withstands impact from 40-in. or larger boulders dropped from feeder.

(2) EFFICIENT VIBRATOR MECHANISM permits screening of sticky ores at extremely high capacities.

(3) CONCENTRATED VIBRATION in the live deck provides thorough action of deepest bed. This motion is isolated from foundation by large, square-end helical springs.

(4) AUTOMATIC CONTROLS limit motion during acceleration and deceleration. Oversize, self-aligning, taper-bore roller bearings, with hydraulic bearing removal device, insure long life and ease of maintenance.

Get complete information from your Link-Belt representative. Or write for copy of Folder 2461.



Two perforated-plate Link-Belt Scalping Screens separate fines from ore fed to primary crusher. Grizzly decks also available.

LINK-BELT

VIBRATING SCREENS

•

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.857

How to switch "rigs" on the go... get "four-for-one" machine utility!

From the seat and on-the-go you instantly get any material-moving action you need with an International® Drott® Four-In-One!

You'll be cascading dirt in dozer position and suddenly need carry-type scraper action. Touch the "machine selector" lever with finger-tip ease, and you have it—to grade, strip, or spread with accurate clam lip control!

Touch! again, for Skid-Shovel position. And with exclusive Drott triple-power, pry-over-shoe break-out action, you can be tearing up and loading stuff as tough as concrete pavement—often where even a power shovel fears to tread!

Touch! once more—and a fast-working clamshell can be gulping aggregate in a space barely big enough to contain your outfit! And giving you a "hopper-high" dumping reach, 30 inches above ordinary roll-forward buckets!

Prove to yourself a Four-In-One will save uncounted hours of changeover time—give 4-machine utility for one moderate investment. Now available in 3 sizes: 1-yard to 2¼-yard capacity, all with the built-in protection of exclusive, shock-swallowing Hydro-Spring. Ask your International Drott Distributor for a Four-In-One demonstration!

Material-Loosening Scarifer Attachment! It's simple to install this scarifer attachment, to speed straight-forward bucket loading. The third or extra valve (which is standard equipment on all Drott Skid-Shovels) is used in this operation. This hydraulic-controlled scarifer has deep penetration, and strength for hard materials. See and try it!

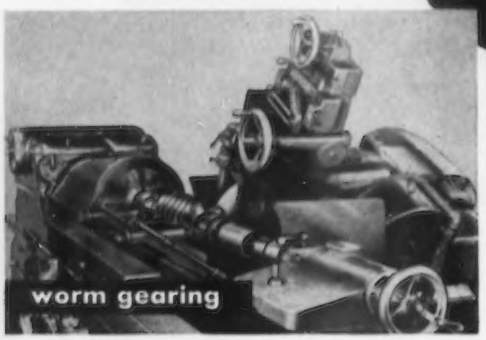
International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 8, Wis.

INTERNATIONAL® DROTT

PHILLIE GEAR®

WORM GEARING

by "Phillie Gear" assures you accuracy...efficiency ...dependability



Worm grinding is an operation which is essential to successful worm gear operation... When worms are heat-treated for maximum surface hardness, the hardening process often produces changes in the lead angle and tooth profile, and always leaves a rough scaly surface on the threads. Worm thread grinding will correct errors of lead and profile, and produce a mirror-smooth surface finish, which is highly important to worm gear tooth action. Philadelphia worms up to 12" pitch diameter, 1 diametral pitch, are thread ground on our modern equipment.

Compactness • High Shock load and over-load capacity • Easy maintenance • Interchangeability of Components • Smooth torque flow • Positive control of work on driven machines • Long service life (worm gearing frequently improves with use) • Trouble-free performance • Good efficiency.

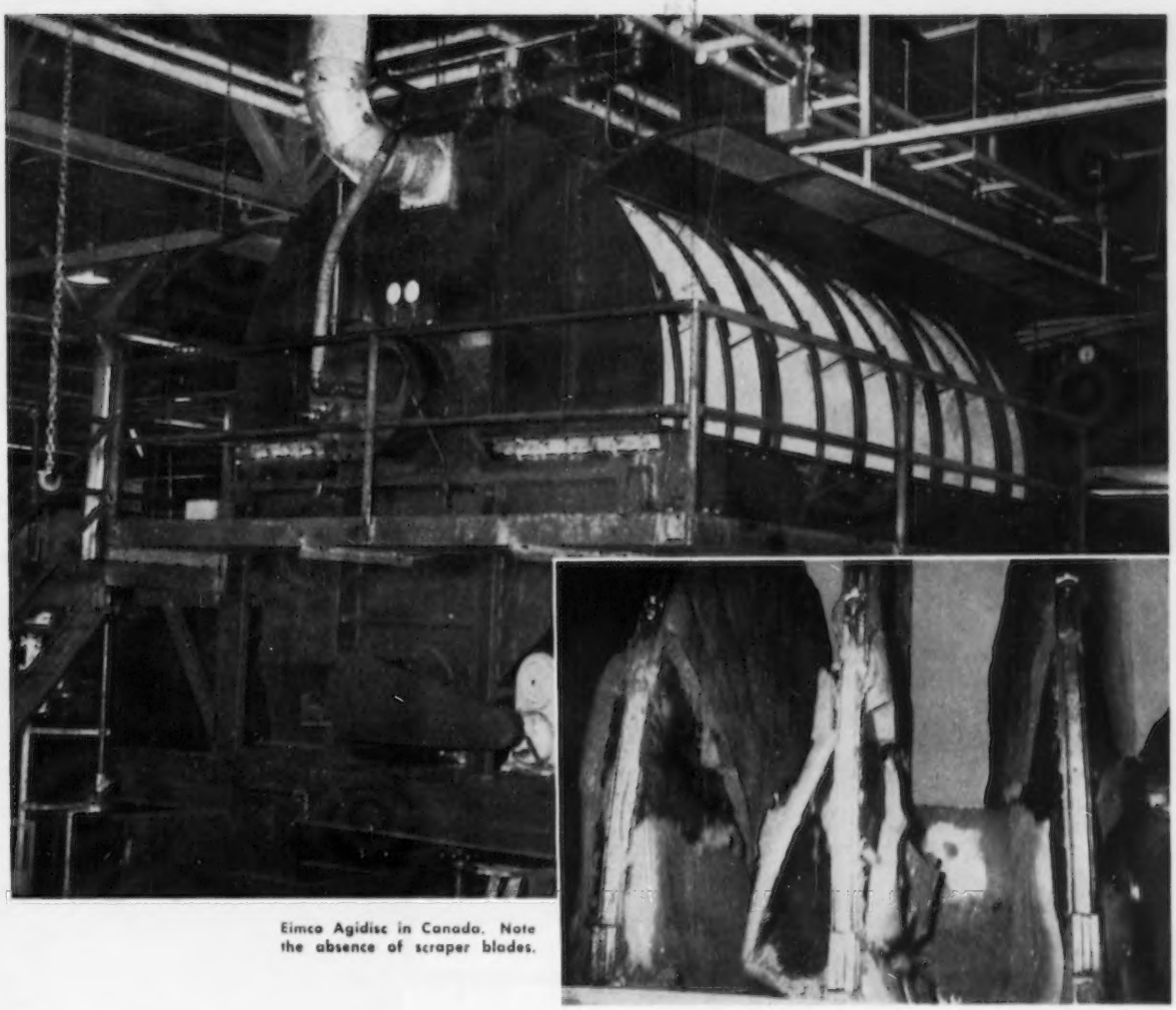
Any Worm Gearing, is, of course, only as good as the knowledge and equipment of its maker, plus the quality of alloys and methods used in making both Worm and Worm gear—This is where "Phillie Gear" is really tops.

Send for 72-page Gear Book #G-655, which tells you all about Worm Gearing, as well as other types of gears.

phillie gear®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET. PHILADELPHIA 34. PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS
Virginia Gear & Machine Corp. • Lynchburg, Va.



Eimco Agidisc in Canada. Note the absence of scraper blades.

HIGHER TONNAGES WITH EIMCO AGIDISC FILTERS

Eimco Agidisc filters work continuously and produce higher tonnages because Agidiscs keep the slurry agitated to optimum density throughout the tank.

The Eimco Agidisc produces a cake that is uniform in thickness over its entire surface, a cake with uniform dryness and has an even distribution of particle size. These characteristics have made it possible for one metallurgical plant to reduce the number of filters contemplated by one half. In another plant on a concentrate, the work done previously by seven filters is now done by four Agidiscs, and in another, one fourth the space occupied by four drum filters (unable to handle the flow) is now occupied by two Eimco Agidiscs which handle the entire flow working about two-thirds capacity.

In addition to the tonnage, dryness and space advantages, Eimco Agidiscs can be equipped with snap blow for most applications. Note snap blow connection in valve of filter shown above and effect on cake (inset). The addition of this cake discharge attachment breaks the cake free of the filter media, prevents blinding in most cases, eliminates scrapers and increases the life of the media.

Eimco engineers will welcome an opportunity to demonstrate the increased savings in your plant through the use of Agidisc filters. Write for complete information.

THE EIMCO CORPORATION

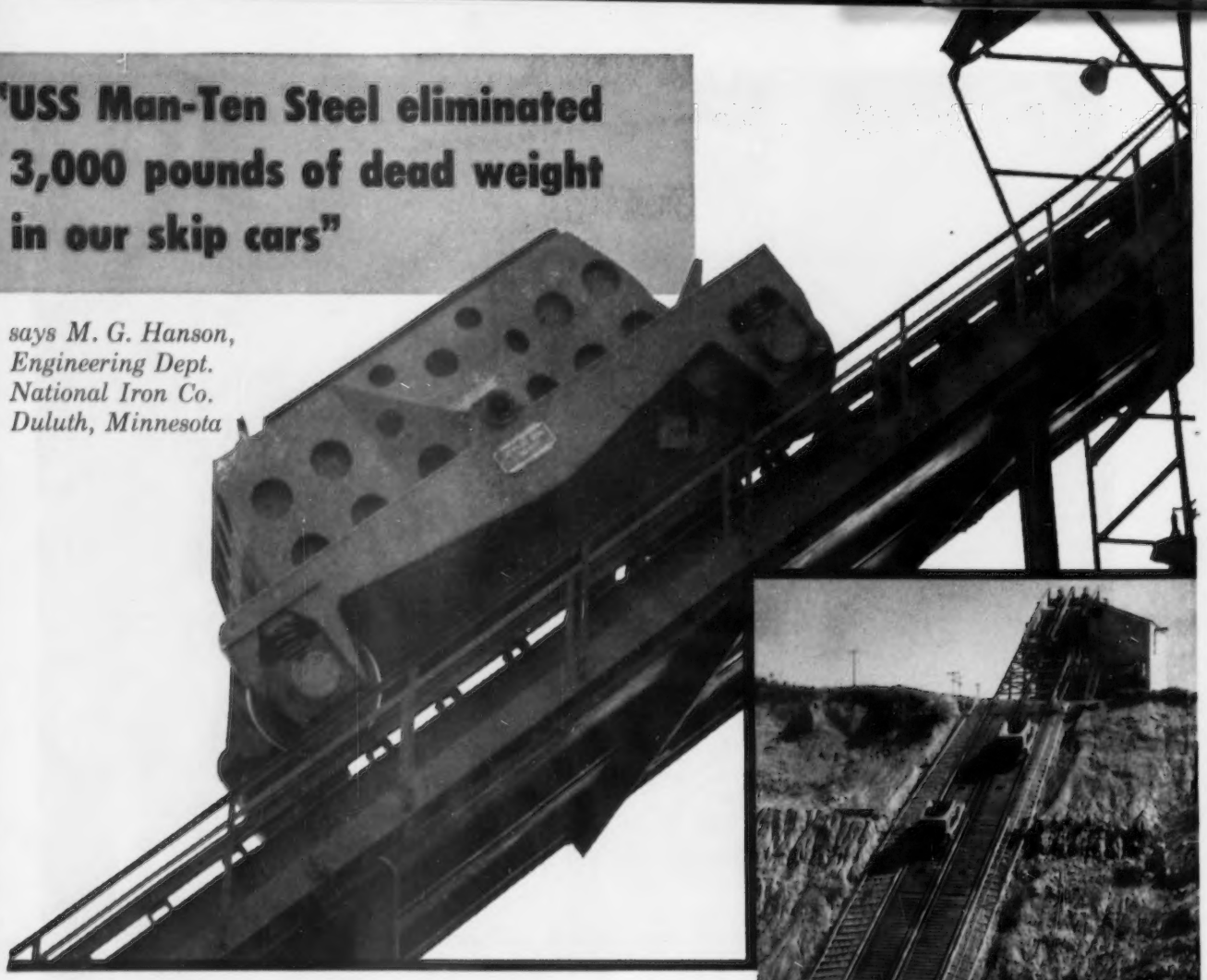
Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-194

"USS Man-Ten Steel eliminated 3,000 pounds of dead weight in our skip cars"

says M. G. Hanson,
Engineering Dept.
National Iron Co.
Duluth, Minnesota



Rockover Skip Cars have to be tough, durable and as light as possible. They run up and down steep inclines almost continually. And because they're dump-type cars they have to resist abrasion.

"Cut down the weight of skip cars," says Mr. Hanson, "and they move faster, carry bigger payloads and require smaller, less expensive hoisting equipment. We accomplished all these things by using USS MAN-TEN Steel in our skips. Because this steel is extra strong we are able to use it in thinner sections to reduce weight, and at the same time maintain the high strength required of our heavy duty cars.

"Here are three reasons why we used USS MAN-TEN in our skip cars: it's easy to work, it's easy to weld, and it resists corrosion."

An accident proved why Man-Ten is best.

One day when a loaded car was halfway up the incline the power failed. Because the brake arrangement had not been set for automatic emergency operation the loaded car crashed to the bottom, and the empty car, used to help counterbalance the load, sailed over the top of the incline and landed 300 feet away. What happened? The loaded car suffered only a bent frame and was returned to service immediately. The empty skip was bent and distorted, but there was no breakage. After being straightened in the repair shop it too was returned to service.

United States Steel produces three different grades of USS High Strength Steel—COR-TEN, MAN-TEN and TRI-TEN—each having distinctive characteristics and each recommended for certain end uses where its specific properties will assure longer service and greater over-all economy. All three grades have a yield point 50% higher than carbon steel and all offer properties which allow greater strength and toughness to be built into the vital parts of machinery, equipment and structures most prone to failure.

In the mining industry these steels can be used to replace carbon steel in the vital parts of mine cars, dozers, shovels, draglines and other such equipment to increase service life without increasing dead weight. And if the use of thinner sections is possible, they can (1) reduce equipment weight without reducing its strength, or (2) increase the size and capacity of equipment without increasing the total weight or the power needed to move it.

For more information, write or call our nearest office.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS HIGH STRENGTH STEELS

USS

UNITED STATES STEEL

Tough Digging in Confined Areas

Eimco 105 Tractor Excavators can work efficiently in small areas because of their built in features.

These features permit the Eimco 105 to work in many places such as narrow ditch digging, tunnels, water channels, mines, railroad cuts, highway widening jobs and numerous others including basement excavation as shown above.

The Eimco 105 features include: (1) Independent track control so that one track can be run forward while the other runs reverse providing spin turns in the length of the machine, (2) Up front position of the operator for better visibility in confined areas, (3) Overhead bucket motion, to eliminate the necessity of turning to discharge the bucket, (4) Simple easy controls, two small handles are all that control the motion of the tractor. Push for forward motion and pull for reverse motion.

Eimco 105 Tractor-Excavators are being used on construction jobs all over the world as well as in mines and quarries. These machines are operating longer periods at lower cost per yard loaded than any other equipment.

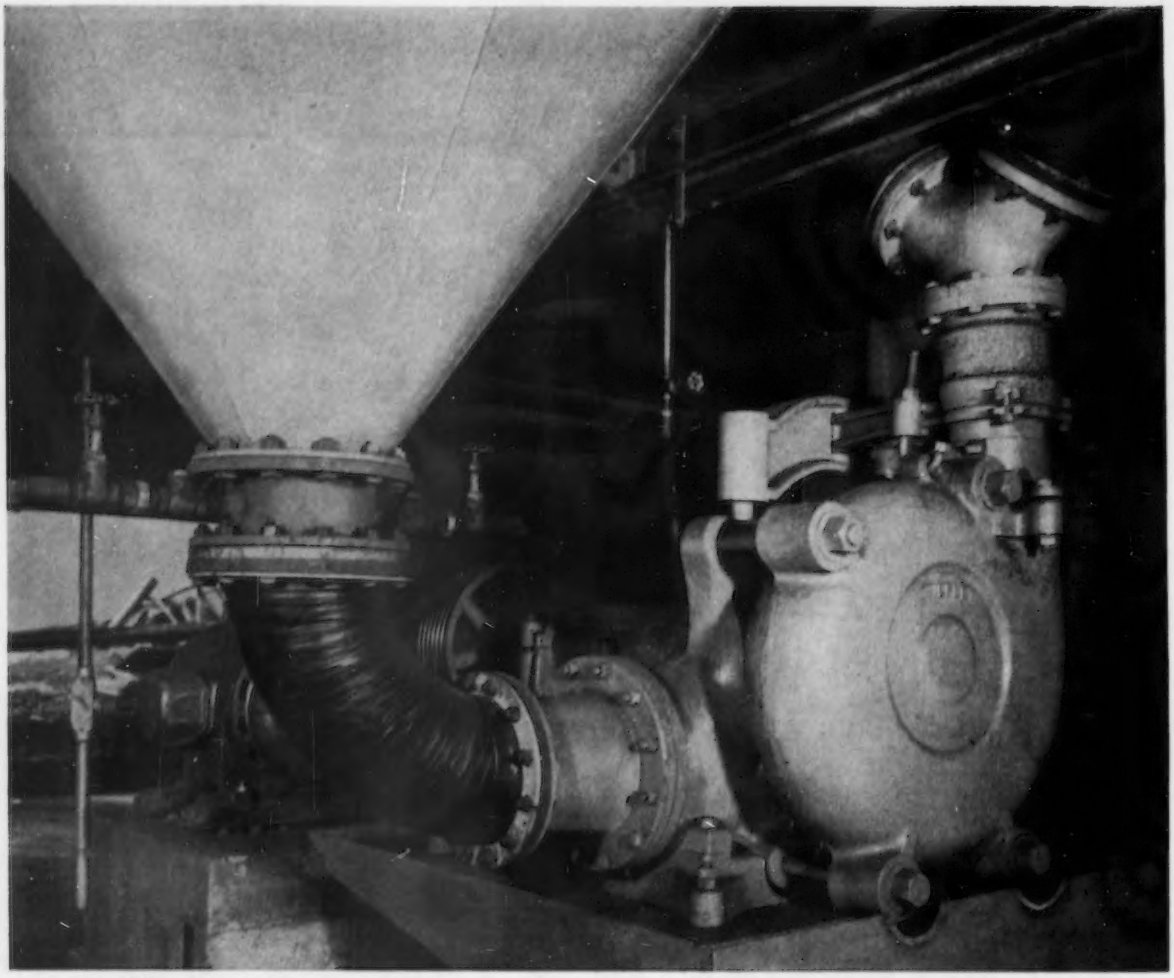
Investigate the Eimco Tractor-Excavator — it is the world's finest crawler tractor equipment.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. **Export Offices: Eimco Bldg., 52 South St., New York City**

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-105



Longer Life and money-saving performance come from the Ni-Hard parts of Wilfley equipment used to pump abrasive solids. Here is one of many Wilfley Model "K" pumps that handle slurry for leading ore producers.

Wilfley + Ni-Hard =longer life for pumping abrasives

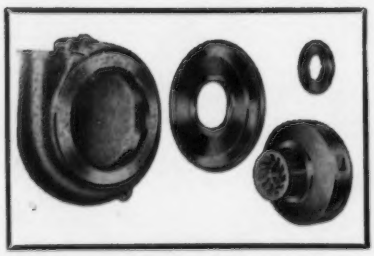
A. R. WILFLEY & SONS, INC., Denver, Colo., is recognized as a pioneer and leading manufacturer of centrifugal sand pumps. Always noted for good service, Wilfley pumps have provided in recent years still longer life with Ni-Hard* nickel-chromium white iron for parts subject to abrasive wear.

Performance records of Wilfley pumps operating under the severest conditions prove that Ni-Hard castings provide maximum resistance to abrasion from solids. This is the key to high output, low-cost pumping.

To Wilfley customers, Ni-Hard parts mean a substantial bonus tonnage of solids pumped between changes. Use of Ni-Hard iron can cut your costs and add to your equipment life.

Specify Ni-Hard, an abrasion-resisting iron, for pumping parts on new and replacement units.

*Registered trademark.



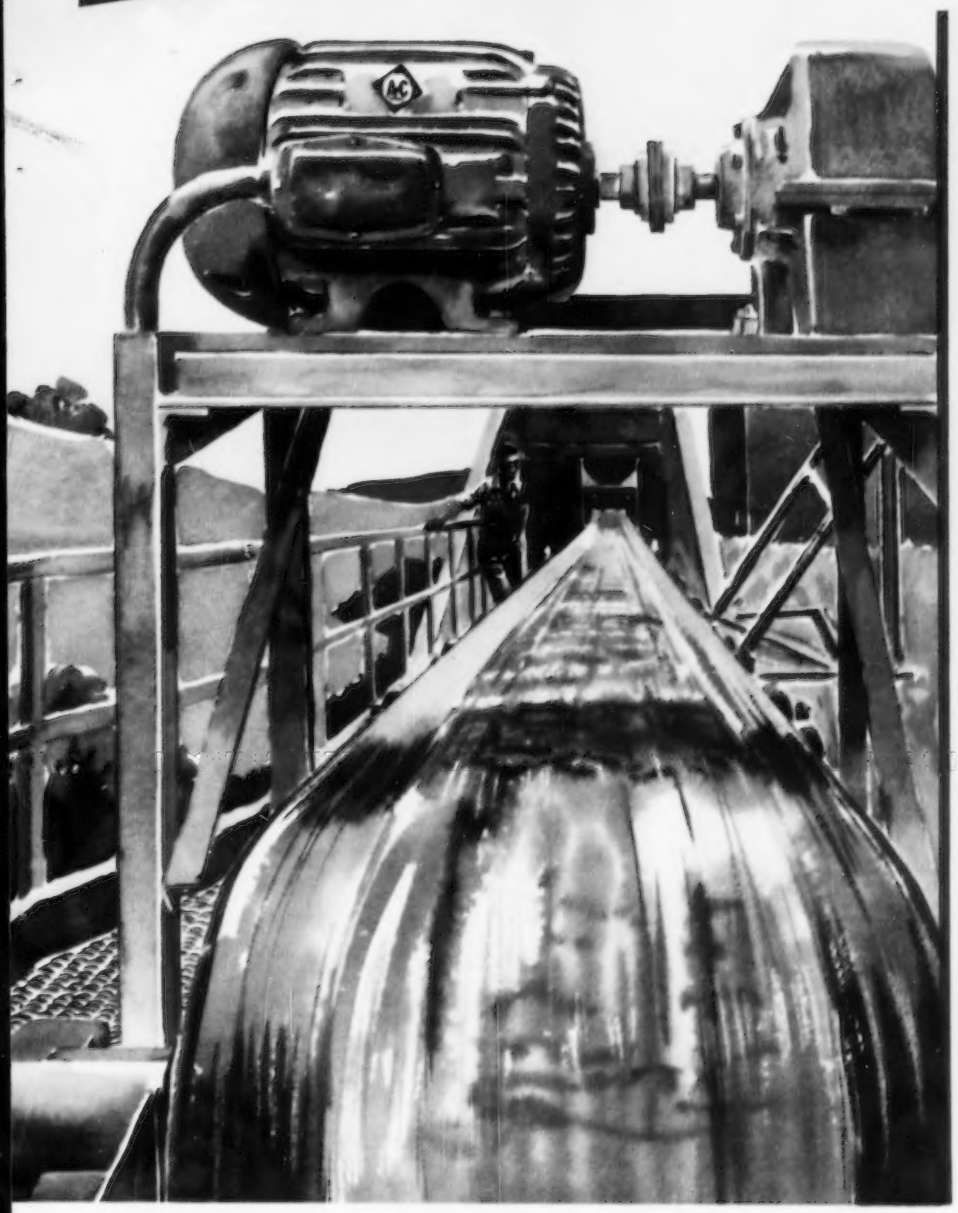
Wilfley pump components cast of Ni-Hard nickel-chromium white iron assure long life and low-cost pumping no matter how abrasive the solids handled.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N. Y.

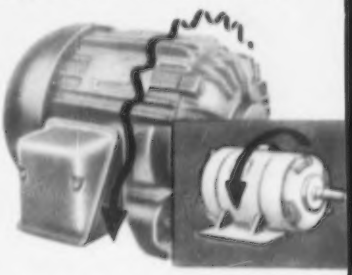
There's MORE

'Round-the-Calendar Operation

with Allis-Chalmers MOTORS



MORE IRON AND COPPER
provide double protection against costly breakdowns. Liberal use of cast iron protects against frame distortion, and greater amount of copper increases electrical life.



MORE COOLING SURFACE
of Allis-Chalmers deep-rib motors makes insulation burnouts highly improbable under normal conditions. There are no external enclosed air passages to become clogged.

A NATIONAL NETWORK
of Allis-Chalmers Motor Distributors is on the job day and night... ready to provide the fast service needed to keep your plant operating 'round-the-calendar.

As a new machinery component or as replacement, specify Allis-Chalmers motors. To find out more, contact your nearby Allis-Chalmers district office, your A-C distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-4906

You get **MORE** when it's Built by Allis-Chalmers

...more convenience... productive floor space ...safety!

ALLIS-CHALMERS
Type H Starters
FOR 2300 TO 5000 VOLT MOTORS

Centralized Control for an entire plant or department

Time-saving, cost-cutting convenience in planning, buying, installation, and operation are all yours with Allis-Chalmers centralized high voltage control. In addition, the factory-assembled lineup, installed in an out-of-the-way location, releases critical floor space for profitable production. From the safety standpoint, the control operates in cleaner atmosphere and can be isolated from unauthorized personnel when located in a separate control room or area.

Low-Cost Installation
Control is factory-assembled and bussed —conduit layout simplified. Lineup requires only one incoming feeder.

Simplified Expansion
Expanding lineup is simply a matter of adding a starter and connecting the bus. Each starter unit is self-contained.

Attractive Appearance
Uniformity of cubicles presents modern, streamlined appearance. Concentrating control in one lineup eliminates cluttered look.

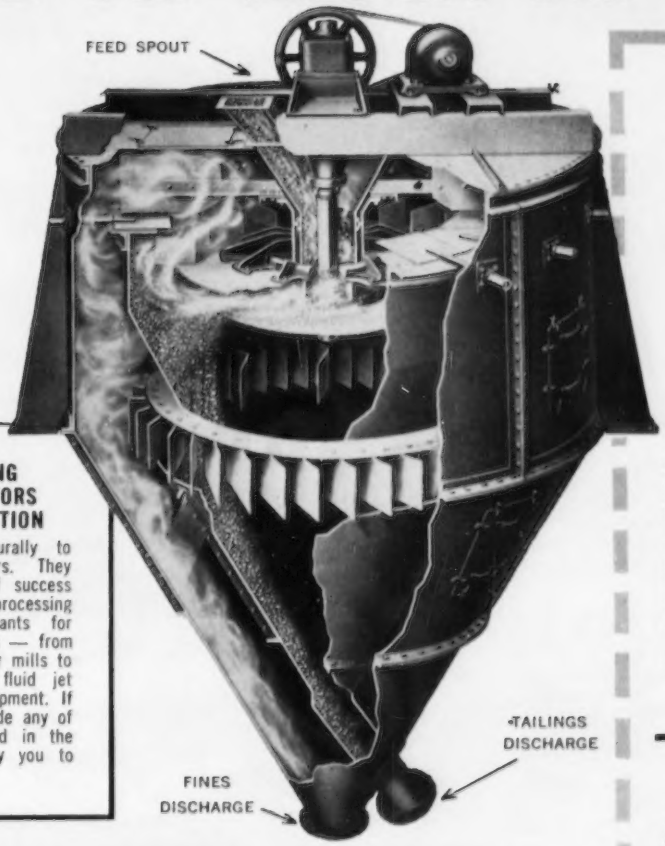
One Company Responsibility
Responsibility for assembling proper devices and for control performance rests with Allis-Chalmers.

For complete information, see your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-4978

40 TO 400 MESH OUTPUT UPPED AS MUCH AS 300%



ENGINEERING AIR SEPARATORS TO SPECIFICATION

. . . comes naturally to Sturtevant engineers. They have a tradition of success in developing dry-processing equipment and plants for more than 75 years — from the first rock emery mills to the most modern fluid jet micron-grinding equipment. If your problems include any of the processes listed in the coupon, it will pay you to investigate.

WHAT CAN A STURTEVANT AIR SEPARATOR DO IN YOUR PULVERIZING SYSTEM?

In the cement industry, Sturtevant Air Separators have a tested record of increasing mill capacities from 25 to 300% while lowering power consumption as much as 50% — when used in closed circuit with grinding mills. Maybe they can do as well for you.

Easily adaptable to your materials. Sizes of Sturtevant Air Separators range from 3 to 18 feet in diameter. They deliver fines from 40 to 400 mesh at rates as high as 100 tons per hour.

Designed to cut costs! Sturtevant Air Separators are built for a lifetime of low-downtime service. Rugged construction plus easy accessibility for quick maintenance (typified by the "OPEN-DOOR" design in other Sturtevant equipment) assures more output per machine-year. Check the coupon for more information.

STURTEVANT

Dry Processing Equipment

The "OPEN-DOOR" to *lower* operating costs over *more* years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

My dry-process materials are:_____

Desired capacity is:_____

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____

STURTEVANT MILL COMPANY, 101 Clayton Street, Boston 22, Mass.

Please send me your bulletin on Air Separators ☐
Also bulletins on machines for:

☐ CRUSHING ☐ GRINDING ☐ PULVERIZING
☐ MICRON-GRINDING ☐ SEPARATING ☐ BLENDING
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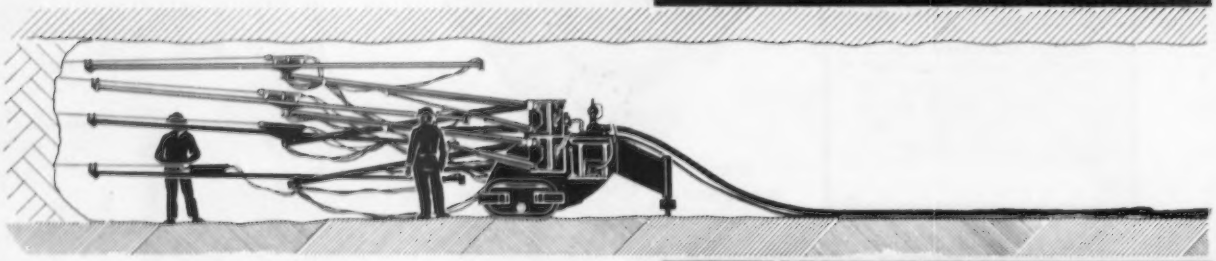
"GISMO Method continues to startle the Industry"... says E. & M. J.

● In a feature article in its March issue, Engineering & Mining Journal announced: "The Gismo, which was first developed as a self-loading cost-cutting transport . . . is more versatile than ever. A full string of mine cars now can be ramp-loaded in sequence, thus expanding the unit's earlier function of speeding the drilling-mucking-loading cycle." The article reveals how this revolutionary system has now proved a tremendous cost-cutting method for development and tunnel work. Reprints will be gladly furnished on request.

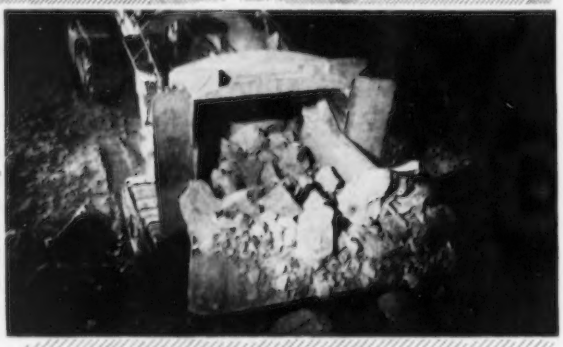
With the Gismo System and Ramp Car combination, and with a greatly reduced crew of men, a new, low cost is apparent for development and tunnel work.

In equipment, you will have a Gismo Drilling Jumbo, a Gismo Self-Loading Transport, a tractor, an incline ramp, any required number of cars, a locomotive and track. That's all! Your work cycle is simple, as shown by the mechanical and photographic illustrations below. Rails are extended, of course, as work progresses.

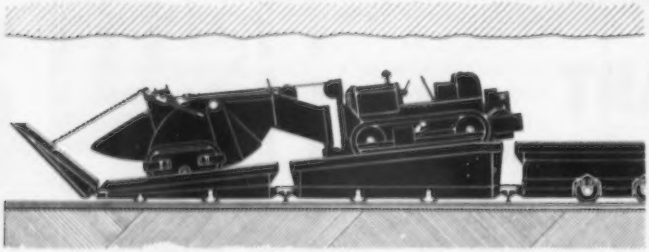
When development work is completed, your Gismo Drilling Jumbo goes into production. The Gismo transport mucks it out. The cars and locomotive transport the ore, usually from surge pocket. For story on the Gismo Method in production work, let us send you a reprint of Mining World's March issue article—"Standard Uranium Mechanizes with Gismos" by Stanley H. Dayton, Associate Editor. *Sanford-Day Iron Works, Inc., Telephone 3-4191, Knoxville, Tennessee.*

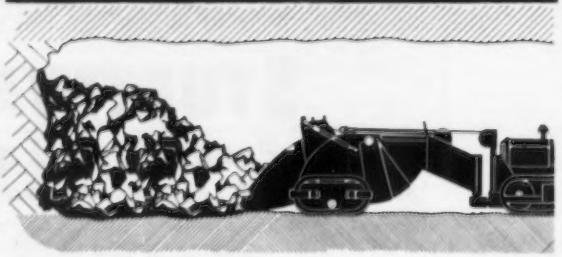


1. The Gismo drilling Jumbo moves in to drill out a round with 4 drills operating simultaneously.



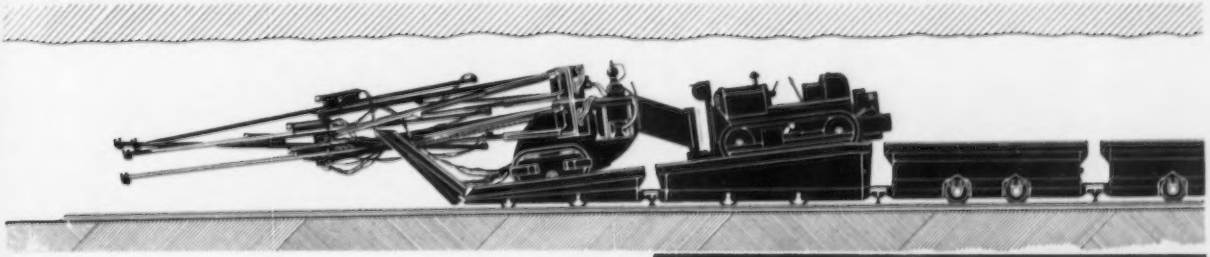
3. In the meantime, rock has been blasted at the previously drilled face and Gismo self-loading transport is brought in for mucking and transporting rock.



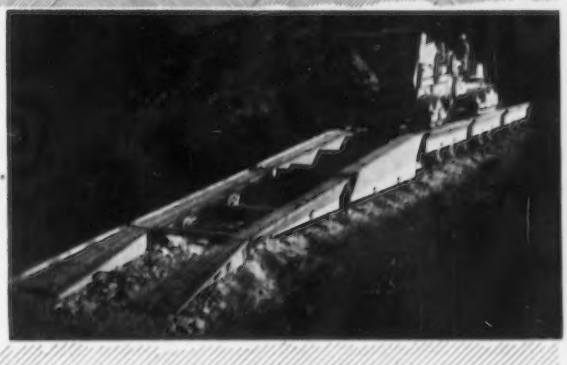


The Gismo Assembly is equipment designed and built for years of rugged service.

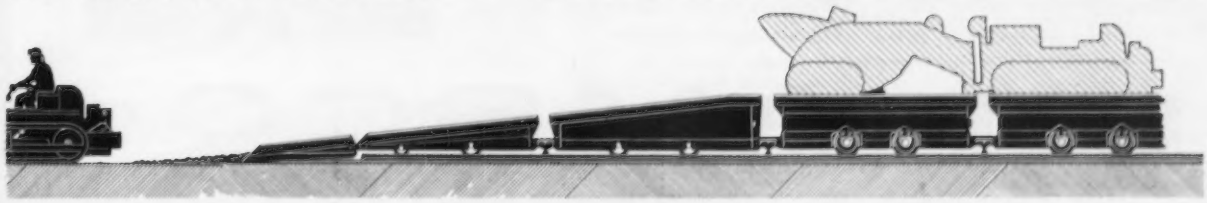
SANFORD-DAY



2. With drilling complete, Gismo Jumbo pulls out from face to car ramp for transfer to another heading.



4. While mucking at one heading, with Gismo Transport loading cars one after another with a complete round of rock, drilling Jumbo is busy at another heading.



How Tractor Operators **Save 50% on Parts Replacement Costs**

Build-up and hardfacing with Amsco® Automatic Welding saves money, doubles service life

The operator shown here is depositing Amsco AW-79 . . . to build up cash savings for tractor operators.

By rebuilding and hardfacing with Amsco Automatic Welding, he is adding *double the service life* of the original part . . . at about *half the cost* of a replacement part.

The Amsco "550" Automatic Welder is specially designed for this heavy-duty service. And Amsco AW-79 Alloy Steel Electrodes provide high impact and abrasion resistance.

Both large contractors and repair shops can make the Amsco "550" pay for itself in short order. Ask your Amsco Distributor for full details on the "550" Automatic Welder and the full line of Amsco Hardfacing Electrodes.

Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.

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OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DELAWARE, OAKLAND, ST. LOUIS, JOLIETTE, QUEBEC

Longyear

Longyear mobile drills tame the Colorado Plateau!

Trailer-mounted Junior Straitline
Capacity - 1350 feet of EW rod

Jeep-mounted "24"
Capacity - 750 feet of EW rod

Truck-mounted "74" (heavy duty)
Capacity - 4000 feet of AW rod

FAST MOVING, VERSATILE LONGYEAR RIGS CUT TIME AND DISTANCE BETWEEN JOBS

PROVED . . . *rapid movement from one drilling operation to another . . . speedy transport of men and equipment.* Longyear mobile drills cancel many problems of distance and rough terrain. Rugged, realistic design assures maximum efficiency in remote areas.

PROVED . . . *time saved in setting up at drill site.* Longyear mobile drills hold setting up time to an absolute minimum. Drill teams arriving at site are ready to start drilling almost immediately.

PROVED . . . *better drilling results at less cost.* Longyear mobile drills are engineered with "built-in" versatility to help you solve a variety of problems, such as:

- proving up metallic and non-metallic mineral values
- foundation testing
- strip mining
- testing quality and depth of coal measures
- revealing the depth and nature of overburden
- soil sampling

Longyear welcomes the opportunity of explaining the advantages of mobile drills in detail. Our recommendations are supported by more than 65 years of experience in solving actual field problems.

Write for General Bulletin #96

E. J. Longyear Co. MINNEAPOLIS, MINN. · CABLE LONGCO

CANADIAN LONGYEAR LTD., NORTH BAY, ONTARIO · LONGYEAR ET CIE., PARIS, FRANCE

ENGINEERING REPORTS:

Powered by General Electric system . . .

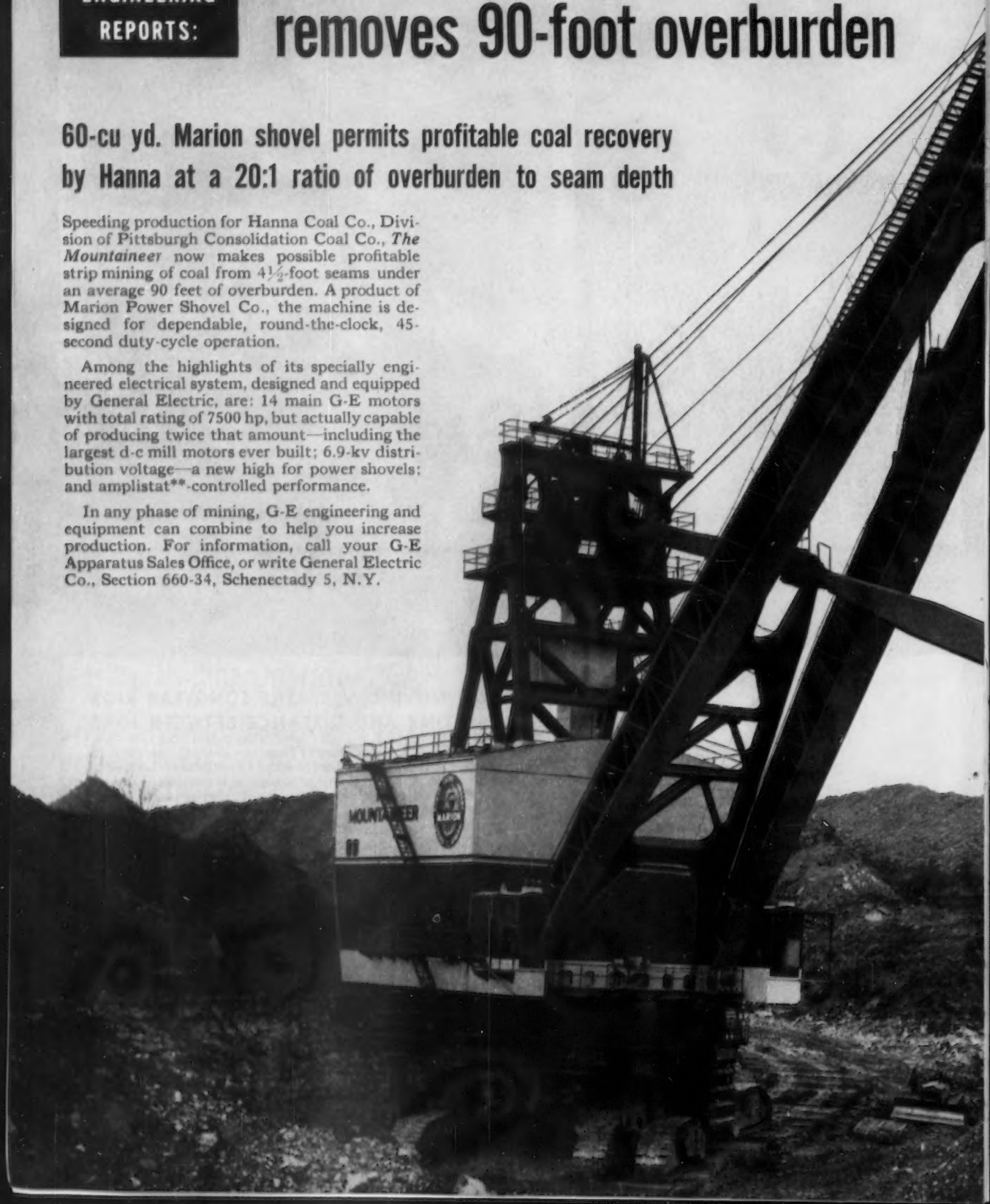
World's biggest shovel removes 90-foot overburden

60-cu yd. Marion shovel permits profitable coal recovery by Hanna at a 20:1 ratio of overburden to seam depth

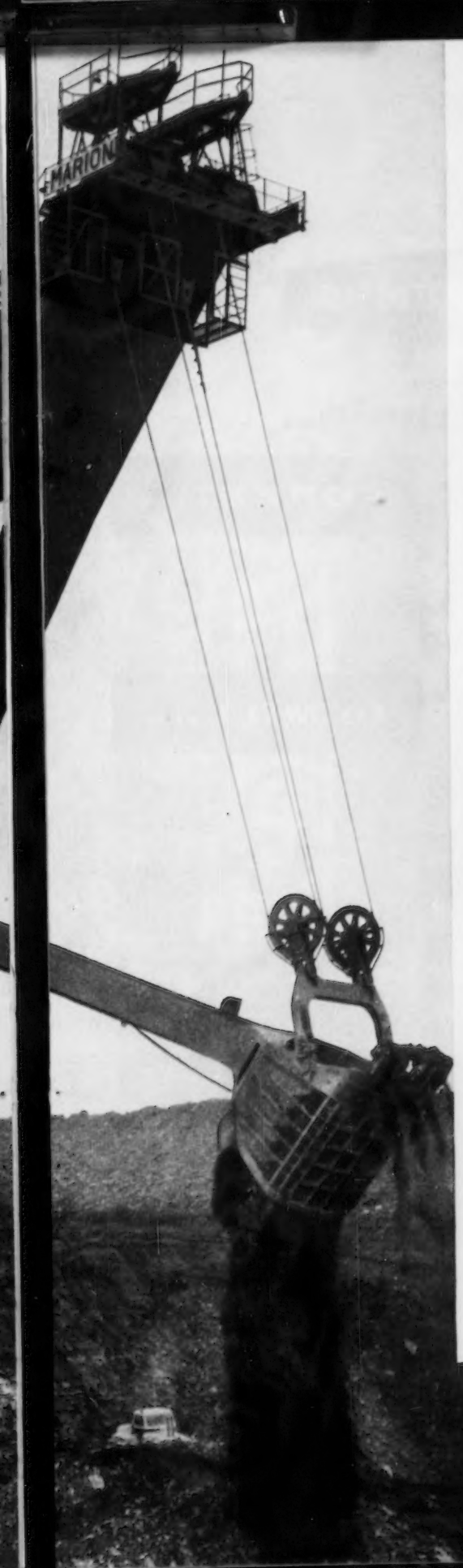
Speeding production for Hanna Coal Co., Division of Pittsburgh Consolidation Coal Co., *The Mountaineer* now makes possible profitable strip mining of coal from 4½-foot seams under an average 90 feet of overburden. A product of Marion Power Shovel Co., the machine is designed for dependable, round-the-clock, 45-second duty-cycle operation.

Among the highlights of its specially engineered electrical system, designed and equipped by General Electric, are: 14 main G-E motors with total rating of 7500 hp, but actually capable of producing twice that amount—including the largest d-c mill motors ever built; 6.9-kv distribution voltage—a new high for power shovels; and amplistat**-controlled performance.

In any phase of mining, G-E engineering and equipment can combine to help you increase production. For information, call your G-E Apparatus Sales Office, or write General Electric Co., Section 660-34, Schenectady 5, N.Y.



CANADIAN TUNGSTEN LTD., NORTH BAY, ONTARIO — TUNGSTEN ET CIE., PARIS, FRANCE



G-E ANALOG COMPUTER enabled engineers of Hanna, Marion, and G.E. to complete in two weeks calculations on design and performance that might have taken three years.

4 RUGGED G-E vertical armored d-c motors, developing 1900 hp, give top performance on high-capacity, heavy-duty swing-motion.

HIGH DEPENDABILITY on a demanding application is provided by four G-E d-c mill motors developing 5000 hp for hoist-motion, equipped with Tri-Clad '55'† blower motors.

SHOCK-RESISTANT G-E armored motors, atop frame, power crowd-motion. Sturdy design helps assure long life on rugged duty.

ABUNDANT DC POWER for operating needs is supplied by two large G-E motor-generator sets. Synchronous motors drive seven generators, which develop 6000-kw peak output.

FINGER-TIP CONTROL of operating functions is provided by adjustable-voltage system with responsive G-E Amplidynes*.

SPEED CONTROL with protection from heavy impact loads during repeated bucket loading, plus simple one-man operation is provided by reliable G-E amplistat control panel.

PROPELLING SHOVEL, four 250-hp G-E wound-rotor motors, powering 8 crawlers, are controlled at second operator station.

*The Amplidyne—rotating amplifier developed by General Electric.
**Amplistat—static amplifier developed by General Electric Co.

†Reg. trade-mark of General Electric Company.

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

WILFLEY SAND PUMPS

A vital link in the chain...

FOREST...

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Clay and other fillers, added to paper while it is in the watery pulp stage, create coated stocks used for superior printing, fine color reproduction and quality writing papers. Dependable Wilfley Sand Pumps handle clay and starch slurries, lime solutions and other abrasive mixtures efficiently and economically . . . deliver continuous, trouble-free performance without attention.

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to PAPER

ENGINEERING AND MINING JOURNAL

MAY 1956

Portia Faces Lead Flotation

EXCEPT FOR BUBBLES in the laboratory flotation cell, the television show in the photograph above has little resemblance to "Portia Faces Life" or any other soap opera. Were it a soap opera, the unctuous opening announcement would probably have been, ". . . the program that answers the question, 'Can a young man find happiness in the metallurgical profession?' As our scene opens, Prof. A. W. Schlechten of the Missouri School of Mines and Metallurgy (center) is explaining to a non-metallurgist what is happening in the flotation cell operated by Prof. A. Legsdin."

But this recent broadcast by the faculty members of the Missouri School of Mines is a whale of lot more important to mining men than any soap opera. It represents, as far as we know, the first attempt of our industry to use a mass medium to reach non-mining people in an attempt to solve an industry problem. The problem: a dire shortage of metallurgical engineers.

Rolla's program was directly designed to interest prospective college students in metallurgical engineering. Starting with a piece of Missouri lead ore, the various steps of concentration of galena by flotation, roasting of the sulphide, reduction of the oxide, and casting of lead were demonstrated on a small scale. The program ended with a discussion of the great demand for young graduates in metallurgy and an explanation of career opportunities in the mineral industries.

Interesting the young man in the mineral industries as a career has been a problem of grave concern to industry leaders for some time. Mining schools particularly, for obvious reasons, have expended considerable effort in this cause, but our congratulations go to the faculty at Rolla for being the first group to magnify their effort by the use television. In engineering terms, TV has supplied a definite mechanical advantage.

How tremendous this "mechanical advantage" can be was demonstrated last month when "The Barretts of Wimpole Street" starring Miss Katharine Cornell was televised. The television audience for that performance was estimated at 28-million which is about 14 times as many people as saw the show on Broadway during it's two runs, on the road and overseas.

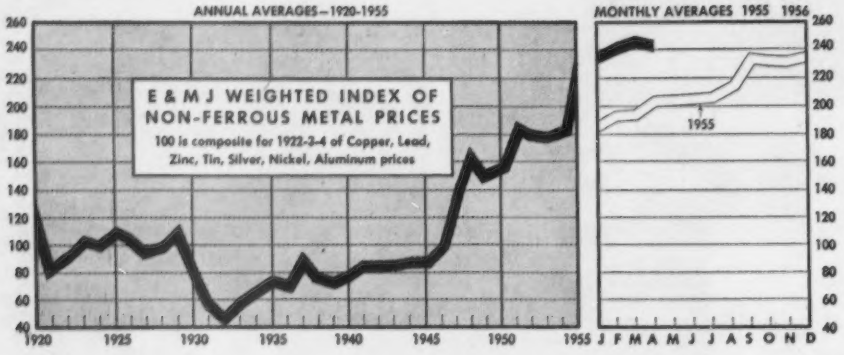
Why shouldn't others apply the "mechanical advantage" of television to reach young men about to decide on a career. We have checked with two leading TV networks and they assure us that time is available as a public service on their part, to televise authoritative educational programs of this type.

And why stop there? As long as the public at large is uninformed about the role of the mining industry and its special problems, we can't expect a political climate which will be any more sympathetic than it has been to date. At our various association meetings, we spend a lot of energy telling each other how important mining is to the nation's welfare and how the Government is hamstringing the industry. Some individuals and companies go a step further and do an excellent job of educating non-mining people in their local areas.

Why not add these efforts together and then multiply them by utilizing mass media to tell the mining story where it will do the most good—to the American people.

E&MJ OUTLOOK

PRICES



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MARKETS

***E&MJ*'s metal price index** moved down 1.78 points from 248.28 in March to 246.50 for April. The decline in the export copper price from 49c at the end of March to 45.25c at the end of April was the chief cause. Silver and tin were down slightly, and aluminum was up slightly.

•

AT HOME

Pacific Coast Borax is transferring ownership to an American company. Owner is Borax Consolidated, Ltd., of Great Britain. Preliminary conversations have been held pertaining to partial ownership acquisition by U. S. Potash Co. Application of boron and hydrogen as powerful rocket fuel constituents has been indicated. Boron is also increasing as a power-boosting additive to gasoline.

American Metal Co., Ltd., is negotiating an agreement with Sabre Uranium Corp. and Pinon Uranium Co., Inc., under which Sabre Uranium would acquire assets of Pinon in exchange for Sabre stock. If the agreement is approved by stockholders, American Metal will participate in development of uranium properties in McKinley County, N. M. Construction of a mill is under consideration.

Phelps-Dodge Copper Products Corp. has been awarded the contract to supply coaxial cable for the 3,000-mile Distant Early Warning line across Alaska and Canada. The cable will operate at temperatures as low as 100 deg F below zero.

•

LABOR

All signs point to tough bargaining sessions for both steel and the non-ferrous metals industries. Attempts of United Steelworkers to divide and conquer by staging selective strikes on June 30 have been forestalled in part by the steel producers who have started notifying steelworkers that they will terminate labor contracts with the union on June 30.

For non-ferrous metal producers, the chief worry is the MMSW fight with AFL-CIO steel workers over bargaining rights. These factions are vying with each other to get highest wage and fringe concessions. Management is caught in the crossfire. See p 110.

•

ABROAD

The engineering shortage is worldwide. It is not confined to the mining industry alone, but to all branches of engineering. Indications are that industry will have to take a more active part in solving this problem. See suggested solutions p 102.

High taxes are putting a ceiling on the amount of capital mining companies can invest for expansion. Stiffer competition for funds available is evident.

Soviet representatives revealed some startling information about progress in controlled fusion in London recently. Mention was made of some kind of high-powered electrical discharge to set off the reaction. This development has aroused interest of nuclear scientists in the U. S.

Copper Prices Tumble in London, Other Metals Weaken Abroad and Here

ECONOMIC ACTIVITY in April was at a high rate; *E&MJ* estimates industrial production at 142% of the 1947-49 level, equal to the Federal Reserve Board's index for March. The index reached its high point, 144, in December. Since then it has shown some weakness.

Non-ferrous metal prices in April dropped to 246.54% of the 1922-24 average as measured by the *E&MJ* index; this is about 1½ points down from March, the highest month. The drop was largely a reflection of the fall in copper prices from 46.728c in March to 46.161c in April. Tin and silver also were down slightly and aluminum rose somewhat.

Copper prices fell rapidly throughout most of April. London prompt prices opened the month at £399 bid and £400 asked. On the morning of May 1 they were at £337½ and £338. At the present exchange rate of about $2.806 per £ sterling, the last named prices are about 42¼c and 42½c a lb. Futures are about 41½c using the same exchange rate and about 41⅝c using the futures exchange rate of a little under $2.79 per £ sterling. Wire bars have been at a premium of ½c to 1c so the effective price is about 43c in the U. K.

Dealers here are willing to sell copper for nearby delivery at 44½c. But they say consumers are not interested and appear to expect further declines.

Top prices received by regular sellers in the U. S. as April opened was about 50½c delivered; at the end of the month custom smelter metal was sold for 45½c. May 1, it could be had for 45c. With dealer prices lower than custom smelters' the latter were doing little business. Custom smelter scrap buying prices have gone down with their selling prices for refined copper. At the beginning of May they were at 35½c and with a weakening copper market there were prospects this price would drop further.

Rhodesian Selection Trust companies, Mufulira and Roan Antelope, announced a price of £350 per long ton for electrolytic copper sold to U. K. consumers, effective Monday, April 30. This price is subject to change on 24 hr notice. The price, about 43.85c, may be compared with the 43c wire bar price in the U. K. charged by some other sellers—the LME price plus a premium for specifiable metal. Speculation in New York is that sales of RST copper may decline if it remains above the LME price by more than the premium. However, there are some offsetting factors.

Anaconda announced that effective with sales for Monday, April 30, her Chilean copper sold in the U. S. will be priced on the LME average of the prompt bid and asked for the week prior to the week of shipment from the refinery only when that average is above the company's domestic quotation. The latter price will be used when higher. The arrangement specifies no flat price. No one was surprised by this announcement. A somewhat similar statement from Kennecott is expected; some feel this will come on May 2 but others believe it will be held off for another week.

The immediate cause of all these developments is the decline in buying, especially in the U. K. and other parts of Europe. There is no doubt demand is down and that in part this reflects a fall in consumption. But in so far as the cause is to be found in the copper industries it lies in the continued rise in output of metal. The decline in consumption and buying lies outside the copper industries. This is in accordance with the changes in the economies of Europe. It is more apparent in the U. K. than elsewhere. The situation became clear earlier in the year when the U. K. Government indicated its anti-inflationary campaign would be vigorous and that metals especially were greatly inflated. But elsewhere in Europe, and to a lesser extent in the U. S., demand has been slow.

How far can copper prices fall? This matter is being debated around the world. For months one has heard the notion, "The higher they go the farther they will fall." They went high because of the shortage of supply relative to demand; presumably they will stop falling when the present reverse situation is over, when demand is no longer short relative to supply. Either demand must rise to heights it has never reached, or the supply coming onto the market must be reduced. U. S. Government orders may have some effect, but analysts say they alone will not be enough. If this is so, declines in output, voluntary or otherwise, or a resurgence in demand, will be needed. If not, then, one hears, price drops can continue until they get into the neighborhood of costs for the high cost producers—then production cut-backs may take over. Contracts by mining firms with the Government in some cases are at the *E&MJ* average but in other cases are at flat prices, apparently around the 30c level including cost escalator arrangements. Some have already run out.

Three all-time records were set in March by the copper industries. World refined output of 258,506 short tons is the highest on record. Deliveries to fabricators of 262,954 tons was a record as was U. S. crude primary output of 100,272 tons.

Copper Institute data show the maximum copper production and deliveries for any one year and the March 1956 figure at an annual rate.

United States

Production:	Maximum	March 1956
Crude, primary	1,111,022(a)	1,203,264
Crude, secondary	135,052(b)	151,140
Totals	1,246,074	1,354,404
Refined copper	1,467,448(c)	1,728,324
Deliveries, refined	1,643,677(a)	1,699,080

World

Production:		
Crude, primary	2,614,271(c)	2,934,864
Crude, secondary ...	145,293(b)	171,504
Totals	2,759,564	3,106,368
Refined copper	2,728,219(c)	3,102,072
Deliveries, refined	2,747,057(c)	3,155,448

(a) 1943 (b) 1949 (c) 1955

There are prospects some of these figures will be eclipsed before the year is out. San Manuel may add considerably to its monthly output and other firms have indicated plans to increase production.

Lead sales continue low. American Bureau of Metal Statistics data show lead stocks held by U. S. producers rose about 10,000 tons in February and again in March. The Government came into the market late in April and probably got much more than in preceding months. For the past week London has been at about £111 for prompt bid; at this price lead can come to the U. S. from some sources more profitably than to abroad. This could necessitate much heavier Government buying here to maintain the price.

Zinc markets are not strong. Auto parts makers have failed to come into the market for Special High to the extent some sellers had hoped. The Government is expected to get more metal. Most sellers seem to believe the Government will be able to hold the price at 13½c by its buying for the stockpile.

A summary of the February and March 1956 statistics of the American Zinc Institute, in short tons, follows:

	Feb.	Mar.
Stock at beginning	41,330	39,833
Production	86,329	91,690
Production, daily rate	2,977	2,958
Shipments:		
Domestic	84,727	84,204
Export & drawback	317	460
Government acc't.	2,782	6,821
Totals	87,826	91,485
Stock at end	39,833	40,038
Unfilled orders	45,255	53,078

Aluminum continues rather tight but there is no doubt it is continually getting easier. This is seen by the decline in the spread between the secondary prices of ingot and comparable grades sold by the primary producers.

Quicksilver strengthened late in April but there were suggestions early in May the market was easing. It reached $268-$270 but many factors feel there is nothing to sustain it. Less metal has been coming on the market.

MARKETS *(Continued)*

Average Prices April (E&MJ Quotations)

Copper:	
Electrolytic, domestic refinery	46.161
Electrolytic, export refinery	46.964
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and sterling exchange:	
Silver, New York, per oz.	90.875
Silver, London, pence per oz.	78.781
Sterling Exchange, "Checks"	280.772
Zinc:	
Prime, Western, East St. Louis	13.500
Prime, Western, delivered (g)	14.000
Tin:	
New York Straits	99.310
New York, 99% min. (e)	98.310
Gold, per oz. U. S. price	$35.000
Quicksilver, per flask	266.560
Antimony (*E&MJ*) (d)	36.470
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$103.000
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	25.900
Magnesium, ingot	33.300
Nickel (f)	64.500

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Cadmium average based on the producers' quotations.
(b) Cadmium average based on the average of the producers' and platers' quotation.
(c) Cadmium average based on platers' quotation.
(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(e) Tin content.
(f) F.o.b. Port Colborne, U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

Volume of international transactions grew 4% in April. Soviet gold sales of about 1-million oz were reported on the continent. The sharp decline of the Turkish lira lead to a limited gold panic in Istanbul. Trading in gold coins was brisk in Western European centers and medium active in Asiaic and South American markets. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Mar. 31	Apr. 30	Mar. 31	Apr. 30
NEW YORK, transit	.....	.....	$35.08*	$35.08
MANILA	$41.25	$42.00	36.00	36.10
HONG KONG	44.30	44.15	38.10	38.05
BOMBAY	56.80	57.15	55.00	56.30
TANGIER	43.00	41.50	34.92	34.90
BEYROUTH	43.00	42.45	35.11	35.12
PARIS	42.85	42.50	35.85	35.75
BUENOS AIRES	38.25	40.00	36.10	35.95

Note: Prices are computed at the free or black market value of the U. S. dollar in the local markets.
* Corrected.

Major Metals

U. S. DAILY AND AVERAGE PRICES

April 1956	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
2	46.375	47.750	16.000	15.800	14.000	13.500	24.000	100.375
3	45.825	47.775	16.000	15.800	14.000	13.500	24.000	100.750
4	45.975	47.225	16.000	15.800	14.000	13.500	24.000	100.000
5	46.825	47.850	16.000	15.800	14.000	13.500	24.000	100.000
6	46.450	48.300	16.000	15.800	14.000	13.500	24.000	100.250
7	No Market	48.300	16.000	15.800	14.000	13.500	24.000	100.250
9	46.875	48.250	16.000	15.800	14.000	13.500	24.000	99.125
10	47.250	47.900	16.000	15.800	14.000	13.500	24.000	99.250
11	46.775	48.100	16.000	15.800	14.000	13.500	24.000	99.250
12	46.100	47.200	16.000	15.800	14.000	13.500	24.000	99.250
13	45.850	47.425	16.000	15.800	14.000	13.500	24.000	99.500
14	No Market	47.425	16.000	15.800	14.000	13.500	24.000	99.500
16	46.275	47.275	16.000	15.800	14.000	13.500	24.000	99.625
17	45.900	47.200	16.000	15.800	14.000	13.500	24.000	99.375
18	46.150	47.125	16.000	15.800	14.000	13.500	24.000	98.875
19	45.800	46.500	16.000	15.800	14.000	13.500	24.000	98.875
20	46.075	45.750	16.000	15.800	14.000	13.500	24.000	98.750
21	No Market	45.750	16.000	15.800	14.000	13.500	24.000	98.750
23	45.925	46.250	16.000	15.800	14.000	13.500	24.000	98.875
24	46.075	46.375	16.000	15.800	14.000	13.500	24.000	98.500
25	45.775	46.500	16.000	15.800	14.000	13.500	24.000	98.500
26	45.750	45.825	16.000	15.800	14.000	13.500	24.000	98.375
27	45.650	45.400	16.000	15.800	14.000	13.500	24.000	99.250
28	No Market	45.400	16.000	15.800	14.000	13.500	24.000	99.250
30	45.700	45.250	16.000	15.800	14.000	13.500	24.000	98.250
AVERAGES FOR MONTH								
April	46.161	46.964	16.000	15.800	14.000	13.500	24.000	99.310
AVERAGES FOR WEEK								
April								
4	46.050	48.371	16.000	15.800	14.000	13.500	23.955	100.188
11	46.835	48.117	16.000	15.800	14.000	13.500	24.000	99.688
18	46.055	47.275	16.000	15.800	14.000	13.500	24.000	99.354
25	45.930	46.188	16.000	15.800	14.000	13.500	24.000	98.708
CALENDAR WEEK AVERAGES								
April								
7	46.290	47.867	16.000	15.800	14.000	13.500	24.000	100.271
14	46.570	47.717	16.000	15.800	14.000	13.500	24.000	99.313
21	46.040	46.600	16.000	15.800	14.000	13.500	24.000	99.042
28	45.835	45.958	16.000	15.800	14.000	13.500	24.000	98.792

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

April 1956	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
2	91.250	Holiday	280.4375	Holiday	$35.00
3	90.750	79.000d.	280.6250	249s. 5¼d.	35.00
4	90.750	79.000d.	280.7187	249s. 3d.	35.00
5	90.750	79.000d.	280.5937	249s. 3½d.	35.00
6	90.875	78.875d.	280.6785	249s. 3¾d.	35.00
7	(e)	(e)	(e)	(e)	35.00
9	91.000	78.875d.	280.7395	249s. 3¾d.	35.00
10	91.000	78.875d.	280.8437	249s. 2d.	35.00
11	91.000	78.875d.	280.8616	249s. 1¾d.	35.00
12	91.000	78.875d.	280.7946	249s. 1¾d.	35.00
13	91.000	78.875d.	280.7857	249s. 2d.	35.00
14	(e)	(e)	(e)	(e)	35.00
16	91.000	78.750d.	280.8258	249s. 1¾d.	35.00
17	91.000	78.750d.	280.9017	249s. 1d.	35.00
18	91.000	78.625d.	281.0312	249s. ¾d.	35.00
19	90.750	78.625d.	281.0401	248s. 11¾d.	35.00
20	90.750	78.625d.	280.8839	249s. 0d.	35.00
21	(e)	(e)	(e)	(e)	35.00
23	90.750	78.625d.	280.8883	249s. 1d.	35.00
24	90.750	78.625d.	280.9375	249s. ¼d.	35.00
25	90.750	78.625d.	280.7812	249s. ¾d.	35.00
26	90.750	78.625d.	280.7187	249s. 3¼d.	35.00
27	90.750	78.625d.	280.5312	249s. 3½d.	35.00
28	(e)	(e)	(e)	(e)	35.00
30	90.750	78.875d.	280.5937	249s. 4¼d.	35.00
AVERAGES FOR MONTH					
April	90.875	78.781d.	280.772	—	$35.00
AVERAGES FOR WEEK					
April					
4	91.000	—	280.485	—	$35.00
11	90.925	—	280.743	—	35.00
18	91.000	—	280.868	—	35.00
25	90.750	—	280.906	—	35.00

Calendar Week Averages: New York Silver: April 7th, 90.875; 14th, 91.000; 21st, 90.900; 28th, 90.750.
(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.8125.

London Metal Exchange Quotations

April	COPPER Cash Bid	COPPER Cash Asked	COPPER 3 Mo. Bid	COPPER 3 Mo. Asked	LEAD Current Month Bid	LEAD Current Month Asked	LEAD 3 Mo. Bid	LEAD 3 Mo. Asked	ZINC Current Month Bid	ZINC Current Month Asked	ZINC 3 Mo. Bid	ZINC 3 Mo. Asked	TIN Cash Bid	TIN Cash Asked	TIN 3 Mo. Bid	TIN 3 Mo. Asked
2	Holiday															
3	399	400	395½	396	120	120¼	118¼	118¾	99	99¼	97	97½	787½	790	777½	780
4	397	397½	392	392½	120	120¼	118½	118¾	98¾	99	97	97¼	772	773	765	766
5	396	397	391½	392	119½	119¾	118	118¼	99¼	99½	97¼	97½	768	769	764	765
6	393½	394	390½	391	119¼	119½	118¼	118½	99½	99¾	97½	97¾	768	770	765½	766
9	384	385	380	381	118¾	119	117½	117¾	99	99¼	97¼	97½	765	766	760	761
10	392	393	385¼	386	118¾	119	117¾	118	99¼	99½	97¾	98	766	768	761	762
11	381½	382½	375½	376	118¼	118½	117¾	117½	99	99¼	97¼	97½	769	770	762	763
12	377	377½	371	371½	117¾	118	116¾	117	98¾	99	97¼	97½	766	767	760	761
13	380	380½	374½	375	117¼	117½	116¾	117	98¾	98¾	97½	97¾	768	770	761	762
16	377½	378	371½	372	116¾	116½	115¾	116	98¾	99	97½	97¾	767	768	760	761
17	373	374	367	368	114	114½	113¾	114	98	98½	97	97¼	763	764	759	760
18	365½	366	359½	360	112¾	113	112¼	112½	97	97¼	95¾	96	760½	761½	757	758
19	363	364	357	357½	113	113¼	112¾	113	98	98½	96¾	97	761	762	756	757
20	364	365	357½	358	113	113¼	112½	112¾	97½	97¾	96½	96¾	764	765	759	760
23	370	370½	363½	364	113½	114	113¼	113½	98	98¼	96¾	97	758	759	757	757½
24	372½	373½	366½	367	113¾	114	113¼	113½	98	98¼	96¾	97	757½	758½	757	757½
25	356	357	350	350½	111¾	112	111¼	111½	96¼	96½	95	95¼	754	754½	754	754½
26	350	350½	344½	345	110½	111	110	110¼	96	96¼	94¾	95	749	750	749	750
27	350	351	344½	345	111¾	111¾	110¾	111	96¼	96¾	95¼	95½	760	761	757½	758
30	343½	344	337½	338	112	112¼	111½	111¾	97	97½	95¾	96	750	751	747	748
Av'g's	£374.638		£369.025		£115.713		£114.938		£98.241		£96.806		£764.275		£759.900	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted.

MISCELLANEOUS METALS

April 30, 1956

Aluminum ingot, 99 plus % lb			(c)25.9¢
Antimony, spot, lb, less than carload, in cases			36.47¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb			$2.25
Cadmium, commercial sticks, delivered, lb			$1.70
Calcium, lb, ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb, contract			$1.25
Cobalt, 97 to 99%, per lb			$2.60
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz			$2.25
Lithium, lb, 98%	$11.00	@	$14.00
Nickel, cathodes, lb, f.o.b. Port Colborne (a)			64½¢
Magnesium, 99.8%, carloads, lb, producer's plants, Freeport, Texas			32½¢
Palladium, troy oz	$23.00	@	$24.00
Platinum (wholesale lots) troy oz	$97	@	$110
Quicksilver, flask of 76 lb, 25 flasks or more	$268(a)		$270
Selenium, 99 plus %, lb. (Feb. 1)			$13.50
Silicon, minimum 97%, carloads, lb			20½¢
Tellurium, lb	$1.50	@	$1.75
Thallium, 100 lb or more, lb			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb			(b)$3.45

(a)Includes U. S. duty. (b)Effective Nov. 23, 1955 (c)March 29, 25.765¢, corrected.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$37.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$23.50	@	$24.50
48% Cr_2O_3 3 to 1 ratio	$44.00	@	$54.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.25
Mesabi bessemer			(b)$11.00
Mesabi, non-bessemer			(b)$10.85
Lead (Galena), 80%, Joplin, Mo., ton			$201.32
Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties $1.27 @ $1.30 c.i.f. U. S. ports, duty extra, nominal. Long-term contract nominal.			
Molybdenum Ore, 90%, per lb of Mo f.o.b. mines	$1.10	@	$1.15
Columbium-Tantalum, per lb, combined oxides	$1.15	@	$1.35
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$33.00	@	$33.50
Domestic, scheelite, 60% f.o.b. mill			$63.00
Vanadium Ore, per lb of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal. (b)Corrected.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb, in bbl carload lots delivered			5¼¢
Cobalt Oxide, 72½% to 73½%, ceramic grade, per lb	$1.96	@	$1.98½
Copper Sulphate, 100 lb			$16.70
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.30	@	$1.33

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr. (4-9% C)			26½¢
Ferromanganese, 74 to 76%, per lb., shipg. pt			10.75¢
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained	$1.54	@	$1.66
Ferrosilicon, 50% per lb of Si f.o.b. shipping point			12¾¢
Ferrotungsten, 72 to 82%, lb of W contained (eff. Feb. 1)			$3.45
Ferrovanadium, per lb of V delivered	$3.10	@	$3.30
Silicomanganese, max. 1½% carbon, lb, contracts			12¢
Spiegeleisen, per long ton, 19 @ 21% grade			$94.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b. Vancouver, B. C. (U. S. funds)			
Spinning fiber	$460	@	750
Shingle fiber, effective Jan. 1	$205	@	$300
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Bauxite, long ton, f.o.b. point of shipment:			
Domestic crude, 50 to 52% (not dried)	(a)$5.00	@	$5.50
Domestic, chemical, 55 to 58%	(a)$8.50	@	$9.05
Domestic, abrasive, 80 to 84%	(a)$18.00	@	$18.50
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$33	@	$35
60% effective CaF_2	$28	@	$30
Acid 97% concentrate, bulk, ton			$47.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00

Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.

Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, prime, Texas, mines, long ton			$26.50
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$58.50
Steel f.o.b. Pittsburgh, billets, net ton			$68.50
Structural shapes, Pa., Ala. etc., 100 lb	$4.50	@	$4.60

Beaverlodge Battles '62 Deadline

DESPITE a cold and particularly drawn-out winter, uranium exploration and development activity in northern Saskatchewan, specifically the Beaverlodge area, is approaching a peak as companies struggle to meet Trade Minister C. D. Howe's deadline of March 31, 1962 for special price contracts.

The applications must be in at that date. To qualify, a company must be able to show satisfactory evidence that it has an economic orebody. There must also be assurance that the property can be brought into production not later than Sept. 30, 1957. Deliveries must be completed by March 31, 1962 at the standard price schedule up to a maximum of $7.25 per lb of uranium oxide provided the concentrate grades better than 10% oxide.

Plant Expansion Due

Mill tonnage capacity is now up to 150 tpd in Beaverlodge for treatment of custom ore by Eldorado Mining and Refining Co. and another 500 tons capacity is in sight when the Lorado Uranium Mines custom plant is built. Eldorado, with a present overall capacity of 760 tons, will be enlarged in 1957 to 2,000 tpd.

Principal shipper at the moment is Rix-Athabaska Uranium Mines; others include Consolidated Nicholson, Nesbitt LaBine, and National Explorations. Companies which are expected to be heavy shippers to the Lorado mill are Gayzor-Athabaska, Black Bay, and St. Michael's. Gunnar Mines has its own 1,250-ton mill for preparing precipitate.

A rundown of exploration and development activity in the last four weeks shows the leading sites to include Radiore, Black Bay, Uranium Ridge, Gayzor, Gulch, Pitcher, Beta Gamma, and Meta, all within a 10-mile radius of Uranium City, which last month achieved self-government and the power to levy municipal taxes for local improvements.

Gunnar Mines is finding that its first mining operations in the open pit (the world's largest for uranium) show a better grade than original surface drilling had indicated. Its new 1100 shaft is expected to be completed late in June when an additional interesting phase of ore development will get under way.

Gunnar Mines' contract with Eldorado is for $76,950,000. Its ore reserves on the basis of pre-production work are estimated to be worth $130-million.

Lorado Uranium has disclosed a substantial tonnage potential at the 220-ft level. Similar ore findings have, so far, not been revealed by work at lower horizons although a large tonnage of good grade ore is available. Lorado has a $44,889,500 custom contract and ore reserves of about 250,000 tons.

Gayzor Mines has scheduled a production rate of 300 tpd on the basis of development results and preliminary diamond drilling completed just before freeze-up in 1955. Levels have been opened at 170 and 320 ft. Most of the activity to date is taking place at 170 ft where one length of 280 ft averaged 0.577% U_3O_8 over a width of 3.5 ft.

Rix-Athabaska is concentrating attention upon its Smitty shaft, which is being sunk for two levels below the previous 250-ft level. This phase is expected to be completed in April. An entirely new shaft for the Leonard series is about to get underway.

Black Bay Uranium is reported sinking a winze from the adit level to open up the downward extension of the high grade uranium ore zone developed at the adit horizon. Raises have already been put through to surface on the various high grade sections and an attractive grade of material has been stockpiled at the adit entrance.

Nesbitt-LaBine Mines, which shipped considerable development muck to Eldorado in 1955 from its Eagle-Ace Mine, is now focussing attention on shaft sinking at the ABC mine where the opening was completed to 850 ft late last January. Underground diamond drilling and work on the third level are providing confirmation of ore deposition indicated by the adit horizon drilling which prompted sinking.

National Explorations, which made minor shipments to Eldorado late last fall, is resuming shipments in April and expects to reach $150,000 revenue a month by late 1956. Considerable good grade uranium ore—up to 5.52% U_3O_8—has been developed from a drift on the second level.

New Development

St. Michael's Uranium, which sank a three-compartment shaft 400 ft with levels at 229 and 364 ft, is now undertaking lateral development of high grade uranium intersections secured in surface drilling. The ore zones lie on the extension of Gayzor structures.

Brunston Mining Co. has resumed diamond drilling on its 15-claim group. According to Hopkins Exploration Consultants, who are directing the program, the intention is to explore a major fault adjacent to a radioactive zone which has been traced for 1250 ft. The fault appears to be an extension or parallel related to the St. Louis fault. Grab samples from zone trenches assay up to 0.88% uranium oxide.

The first hole to be put down will be drilled 500 ft to reach mafic formations underlying a shallow capping of arkosic rocks as well as to intersect the footwall of the fault.

Camdeck Mines, which has holdings adjacent to the Eldorado properties, plans shaft sinking, drifting, and further diamond drilling as soon as finances can be arranged, according to the president, D. F. Hurd. Nine radioactive showings have been revealed, most of them containing uranium values over narrow widths. More than 7,500 ft of drilling last year failed to establish an orebody although several of ore grade were cut in favorable rock types.

Adjacent to Nesbitt-LaBine holdings, Baska Uranium Mines has signed a contract for a minimum of 5,000 ft of diamond drilling to explore the Taupe fault at depth in its Melville Lake group. Drilling is now under way. This fault (possibly an extension of the St. Louis fault) crosses the Baska Melville group from a distance of 2½ miles and enters Baska property 1,600 ft from the new Nesbitt-LaBine shaft.

Ad Astra Minerals has announced that it will spend about $190,000 this year, compared with $130,000 in 1955, for exploration expenditure on its three uranium prospects in the Beaverlodge area.

Gulch Mines properties, located about 7 miles north of the Gunnar mine, is being developed by drilling ahead of the north face on its 500-ft level to cut 32 ft averaging 0.24% U_3O_8. The intersection is in virgin ground and appears quite different from earlier findings, being associated with heavy pyrite mineralization. It lies 280 ft ahead of the face which in turn is 1,000 ft north of the shaft.

In the main section of the mine several good oreshoots are now being opened, according to the president, J. A. Grant. Preparations are under way to deepen the shaft for three additional levels to 1,000 ft. This program will include 5,000 ft of lateral work and 15,000 ft of diamond drilling.

Crackingstone Mines is about to resume diamond drilling on its original uranium property adjoining Gunnar Mines, according to its president, G. C. McCartney. The new program, being undertaken from the ice on Dome Lake, will permit further investigation of some of the intersections pulled in the initial drilling carried out in this area several years ago, by Dome Mines. One of the early holes returned 0.104% across 26 ft.

Crackingstone Mines has a one-third interest (vendor) and a one-third participation interest in the recently formed Black Cliff Mines in the same general area adjoining Gulch Mines on the northeast. Exploratory drilling is to be undertaken in this 19-claim group as soon as the snow goes.

Meta Uranium Mines, which recently suspended operations in the Beaverlodge area after doing considerable work, is negotiating for a new property in British Columbia. The company reports, however, that its Beaverlodge claims are

being held in good assessment standing.

Current underground work has revealed six drift faces in ore at Lake Cinch Mines, a potential uranium producer in the Beaverlodge area, according to the president, V. R. Mathews of the parent Viloamac Mines. He reports that the grade is significantly higher than was indicated from surface drilling.

On the 500-ft level drfting has extended the main oreshoot to 350 ft with grade across drift width averaging 0.58% (U_3O_8) equal to $84.10 based on the federal price of $7.25 a lb.

Alcoa Schedules New U. S. Smelter Capacity

A boost in aluminum-making capacity of 20% for Aluminum Company of America is due in mid-1958, when construction of a 150,000 ton smelting plant is completed near Evansville, Ind.

A coal-powered project, the Ohio Valley plant will take power from a 375,000 kw steam power facility which will use solid fuel from Peabody Coal Co. Cost will be $80-million.

Plant facilities will include ingot-casting machines, a carbon plant for anode manufacture, machine shops, electrical shops, a rectifier station, office and service installations.

Alcoa says the new plant will increase its installed primary capacity, existing and planned, to 942,500 tons. At year-end 1955, the annual rate was about 700,000 tons. (Part of a current 86,000-ton expansion of smelting capacity at Alcoa's Texas and Washington plants has been completed.)

Phosphate Lease Expansion

House Interior subcommittee is studying legislation which would double the amount of public land any single company might lease in a single state to develop additional reserves of rock.

As we went to press . . . .

Expanded open pit operations will result from a $40-million program at Kennecott Copper Corp.'s Ray (Ariz.) division, as well as a new smelter at nearby Hayden. Mining limits of the pit will be extended, giving an increase of 20,000 tons annual output.

Nearing completion at Ray is a $4.7-million leach-precipitation-flotation plant which will recover an additional 2 lb copper per ton of ore.

Pacific Coast Borax, subsidiary of Borax Consolidated Ltd., a British firm, will be organized as an American company, company officials announce. An expansion program would also result from such an organization. Negotiations are reportedly under way with U. S. Potash Co. toward a merger of the two companies.

Sabre Uranium will acquire assets of Pinon Uranium Co. in McKinley County, N. M. under an agreement signed by the two firms and American Metal Co., Ltd., the latter to manage uranium properties owned by Sabre. American Metal, which is investigating $4.5-million in the new company, will direct development of the properties and erection of milling facilities.

Newmont Mining Corp. and Natomas Co. have joined a venture with Goldfield Consolidated Mines Co. to explore an area in Ethiopia covered by a prospecting lease granted the latter company. Original work will be directed toward a gold placer operation on the Mormora River. Under the lease, all assigned areas may be prospected and, leases taken for mine operation for all minerals but petroleum and petroleum hydrocarbons.

American Chrome Co., a subsidiary of Goldfield, has formed Chrome Metals Co., which reportedly holds a patent for producing high purity chrome.

Late summer will see manganese production from the Icomi-Bethlehem Steel deposits at Amapa, Brazil (E&MJ, August 1955, p 72), following completion of a railroad connection with the port on the Amazon. Work on the project started five years ago.

Control of the Gulf Sulphur Corp. holdings in Mexico (E&MJ, January 1955, p 72) has been purchased by E. J. Hudson, Hudson Engineering Corp., Houston and Bear, Stearns & Co., New York. Purchase from the Brady Brothers, Mexico City, included the latter's minority holdings in Mexican Gulf Sulphur Co.

Nation's newest and biggest titanium reduction plant went into operation at Ashtabula, Ohio in late April when Electro Metallurgical Co. produced its first commercial batch. Operation was also the first commercial production of titanium sponge in the U. S. by a method other than the magnesium-reduction process: new plant uses sodium, to reduce titanium tetrachloride. Electro Met is a division of the Union Carbide and Carbon Corp.

Johns-Manville has assured an Australian producer of a 7,000 tons per year market for the next 5 years via an agreement signed by the firm and Australian Blue Asbestos, Ltd.

Behind the By-Lines...

G. P. Lutjen

This month's cover should be seen in technicolor to be fully appreciated. That's the way it first appeared on the 1954 annual report of Texas Instruments Incorporated, to whom we are indebted for their kind permission to use it on *E&MJ*. So striking was the four-color rendering of the original, that we had carefully saved it for future inspiration. When we edited this month's lead article it just looked like our germanium story and the TI cover were made for each other. No time was lost in establishing communications with TI headquarters in Dallas. We explained our problem and asked for their help. And help we got, beyond measure. So much, in fact, that it was only a difference in printing processes that prevented *E&MJ* from having its first four-color cover in 90 years. We can't say enough for the kindness and courtesy shown us by our friends from Texas.

Of course it was no accident that the TI annual report cover should be so appropriate because the company is one of the leading manufacturers of semiconductor products and you can't talk about germanium without talking about semiconductors. The 25-year old company made the transistors that broke open the consumer market—low cost, radio frequency grown junction units used in the first transistorized radio. For two years the company was the exclusive manufacturer of high temperature silicon transistors and is still the largest supplier. And last month TI announced a new "grown-diffused" production technique, which, according to reports, has resulted in "the highest frequency transistors, both germanium and silicon, commercially available."

E&MJ readers may be more familiar with two of TI's wholly owned subsidiaries. Geophysical Service Inc., a pioneer independent reflection seismic contractor, is one of the world's leading suppliers of contract geophysical services. GSI actually was TI's founding company and now has 67 seismic, gravity and core drill field parties at work in 18 countries.

Houston Technical Laboratories is a topflight manufacturer of geophysical instruments, including reflection and refraction seismic systems, lightweight quartz-element Worden gravity meters and other electrical, resistivity and electromagnetic systems.

In thanking Texas Instruments for aiding and abetting us via their 1954 annual report, we perhaps should add a note for their 1955 edition which could easily have been the keynote of the report on the next few pages. We quote: "Market potential for semiconductor devices in 1956 and beyond verges on the spectacular. . . . Increasing familiarity of engineers with the advantages of transistorization bids fair to break down the last major barrier to common acceptance. More equipments are being designed around transistors and diodes with resultant increased reliability and decreased size, weight and power demand. Improvements in frequency range, power output and other characteristics will open many new fields of application in computers, communications devices, guided missiles and other military and industrial electronic systems."

Translation of this into colloquial germanium is handled on the immediately following pages.

Hot air seems to be something we'll have to put up with as long as any of us have television sets. One group of citizens that doesn't have to put up with hot (and dusty) air is the crew operating equipment in the open pit mines and quarries. Our authority for this statement is the Johns-Manville Co. How they alleviated the situation in a hot and dusty California mine is described on pages 92 through 95. How they did it and how it paid off is yours for five minutes worth of reading time.

Our man-bites-dog department has an item this month. You may recall that the *E&MJ* Outlook page gave fair warning a month or two ago that the oil industry was invading the mining field on a sizable scale. In view of this it is only fair to report that a mining company has just made history in the oil industry. Freeport Sulphur has obtained oil production from a depth of four miles. A wildcat well near Louisiana's Lake Washington field, about 40 miles south of New Orleans flowed at the rate of 472 barrels of 38 gravity oil per day in a recent test of a section from 21,443 to 21,465 ft.

Total cost of the well, which reached a world's record total depth of 22,570 ft, was $2.4-million which was shared by Freeport's partners, Richardson and Bass of Fort Worth, and John W. Mecom of Houston.

Among the problems encountered was the temperature at the bottom ranging up to 350 deg F which affected the tools, instruments, cable and the chemistry of the drilling mud. The mud alone, an extra heavy mixture weighing 18 lb to the gallon, cost about $750,000. Drilling required 107 bits and to make replacements the crew had to haul the four miles of drill stem out of the hole every other day. In the early days, the crews made several hundred feet of hole a day. Below 21,000 ft, progress was 30 to 35 fpd.

Perhaps it's high time we told these oil people about an old mining expression—"She's deep enough!"

Despite the odds that most *E&MJ* readers get to see the excellent Safety News Letter put out by H. B. Humphrey of USBM's Health and Safety Division for the Mining Section of the National Safety Council, we feel obliged to report a story from the March issue which was published frankly under the heading "Jokes".

It seems a Scot had worn the same hat for 20 years, finally realized that it was no longer wearable, and that he had to get a new one. With a heavy heart he walked into McIntosh's haberdashery.

"Well, Mac," he said resignedly, "Here I am again!"

what lies ahead for

GERMANIUM

Will two huge new sources be able to provide enough germanium to meet the mounting demand?

SOARING DEMAND for semiconductor devices in industry has changed the demand situation for germanium, presently the most popular of the semiconductor materials, from near apathy to near desperation in the last twelve months.

At the same time two important new sources of production have come upon the scene. Tsumeb Corp., producing Ge concentrates from the copper concentrate of its Moroccan mines, and Union Miniere du Haut Katanga, producing concentrates from the flue dust of the Kolwezi smelter, will be capable by the end of 1957 of supplying more germanium than any of the present producers in the field. Further, the African production alone will equal the total supply of germanium available in 1955. And if the market demands so require, production could be doubled again in ensuing years. With vast reserves in terms of the scale of germanium usage, African supply depends only on the capacity of the refining plants in Belgium which treat the concentrates from both companies.

For the first time, the complete technical story of germanium production from Africa and Belgium is told in this article, starting on page 78.

Meanwhile let's take a look at the impact of this production and today's pressing demand on the germanium industry. To assess the future more clearly, let's start with the background of germanium and its role in modern industry.

Where Does Ge Come From?

Germanium never occurs in the free state and it seldom occurs in sufficient concentration to allow exploitation. Very few minerals contain appreciable amounts of germanium, and it is at best a secondary constituent.

Argyrodite (Ag_8GeS_6) contains 6 to 7% Ge and **germanite** (7 Cu S, $FeS.GeS_2$), 8.7% Ge; these are the principal germanium minerals but both are considered to be relatively scarce.

Canfieldite (Ag_8SnS_6) contains about 1.8% Ge and is found in small quantities in Bolivia. It cannot be considered a commercial source of germanium.

Renierite, a complex copper-iron-germanium-arsenic sulphide, has been reported at the Prince Leopold copper mine of the Union Miniere du Haut-Katanga, Kipsushi, Belgian Congo. Clean renierite shows an average of 7% Ge and appears to be in sufficient quantity for commercial exploitation.

Acknowledgment

Engineering and Mining Journal wishes to acknowledge its appreciation to Messrs. Frank W. McQuiston, Jr., Leslie J. Bechaud, Jr., Carl B. Allen, and Richard A. Young for their contributions to this article on germanium in this and the ensuing technical discussion.

We would also like to thank the many other people in the germanium industry who gave so generously of their time, information and opinions.

Special thanks are due the officers and staff of the Societe Generale Metallurgique de Hoboken for their extreme and ever courteous cooperation in making available the information pertaining to the development and operation of the vertical retort process. Acknowledgment is also due to the Tsumeb staff, to Battelle Memorial Institute, and to American Cyanamid Company for their valuable contributions to the extractive metallurgy of germanium, Mr. Charles F. Allen (deceased) of the latter company, through his untiring and enthusiastic efforts, was instrumental in laying a firm foundation on extraction processes for Tsumeb concentrate.

Enargite (Cu_3AsS_4) is found in the western U. S. and is reported to contain as much as 0.03% Ge. It has thus far been unexploited.

Most common occurrence of germanium is in very small quantities (0.01 to 0.1% Ge) within the molecular structure of other minerals, such as silver, tin, copper, zinc and iron ores. It occurs most abundantly in the sphalerite (ZnS) of low-temperature deposits, in quantities ranging from traces to tenths of 1%. Cinnabar sometimes contains germanium in tenths of 1% and enargites contain up to 0.1%. Pyrargyrite (Ag_3SbS_3) from the silver mines of Bolivia contains up to 1.0%, and some tin-bearing sulphides have 0.5% Ge. These traces cannot be economically recovered from the ore, but in some cases germanium can be separated as a by-product during the recovery of the primary metals.

Some zinc concentrates originate in the Illinois-Kentucky fluorspar district, and contain from 0.03 to 0.07% Ge. At 75% recovery, this deposit hopes to make available 5,000 to 6,000 lb of germanium per year for the next six or seven years.

A more promising source is the Belgian Congo, where zinc ores encountered at depth run several hundredths of a per cent in germanium. No quantitative estimate of this reserve has yet been made.

Germanium is found in coals from many parts of the world. Under proper conditions of combustion, germanium is retained in the ashes or other by-products of the burning. Exploitation of this source is dependent on sufficient amounts of germanium in these by-products to allow economic recovery. Only in England has such extraction been attempted on a commercial scale. Quality is still a problem and the price high, but improvement is expected. The Ge content averages 0.75%, with occasional samples running up to 2%.

How The Semi-Conductor Business Is Growing

	1954	1955
Transistors, units	1,317,000	3,647,000
Transistors, dollar volume	$4,760,000	$12,253,000
Diodes, units	13,163,000	20,163,000
Diodes, dollar volume	$9,344,000	$18,400,000
Total units	14,555,000	23,810,000
Total dollar volume	$14,104,000	$30,653,000

The coal seams of the Appalachian region have been subject to intensive research. Results to date are not encouraging but still inconclusive. Spot checks of the vast North Dakota lignite resources show up to 0.2% germanium oxide. Available germanium could be substantially increased if low concentration in coal deposits could be recovered.

Where Does Ge Go?

Germanium belongs to that class of materials known as semi-conductors—its electrical properties are somewhre between a metal and an insulator. A metal conducts electricity because it contains a large number of free or mobile valence electrons. An insulator, on the other hand, is unable to conduct electricity because virtually all its valence electrons are strongly tied up in inter-atomic bonds. A semi-conductor has valence electrons which form inter-atomic bonds but these bonds can be easily broken. The semi-conductor conducts some electricity at room temperature but valence electrons can be freed by thermal agitation or by introducing an "imperfection" in the electronic structure.

Small diced pieces of metallic Ge which are used in fabrication are less than 1/12th of the germanuim dioxide that originally started on its way towards reduction and purification. For certain uses small diced wafers are desirable but for other applications it is necessary to grow a single crystal. A part of a crystal called a "seed" is put into a crucible of molten germanium and this seed is rotated at high speed and is gradually withdrawn. Certain additives of "dope" are put in the molten germanium to impart desired specific properties.

For example, if you introduce an impurity such as arsenic into pure germanium it creates important changes. An atom of arsenic replaces an atom of the germanium in its normal position. Because only four of the five valence electrons possessed by arsenic can link up with four valence electrons of the germanium, one electron is left to roam through the crystalline lattice. This electron is available to conduct electricity and is called "N-type conduction" (negative).

If, however, the impurity which was introduced had three valence electrons such as indium, then there would be a situation where the impurity atom is unable to complete the balanced system of valence bonds surrounding the germanium atom. This creates an electron deficiency or a hole. If an electron from an adjacent bond attempted to fill this hole then it would leave another hole behind it. This is considered a "P-type" because these holes behave as positively charged particles.

Single crystals are grown for the most part by the producers of the products in which the germanium is used. Each manufacturer has certain closely guarded techniques which he feels make his products better than his competitors.

In the electronic industry germanium is used principally in three products, (1) diodes, (2) transistors and (3) rectifiers.

A diode is a type of rectifier which is similar in construction and operation to the old crystal and "cats whisker" arrangement used in the early days of wireless. An incoming alternating current signal is fed through the diode and it comes out as a pulsating direct current which is a far more usable form. In the diodes only a P-N junction and two leads are necessary.

The transistor is a device which transfers an electric signal across a resistor. It was invented in 1948 by J. Bordein and W. H. Brattain of the Bell Telephone Laboratories. It is a three element (in effect two diodes connected back to back) control device which utilizes a small current to control a larger one. Diodes and transistors require no hot filament and they usually operate with one millionth the power of the vacuum type doing the same job. The transistor is very small —about the size of a hairpin. It is very efficient and durable—with shock resistance and a very long life. The heart of the transistor is, of course, the germanium crystal which is attached to the three contacts and which entire sub-assembly is put into a hermetically sealed package. The first transistors were the point contact type with the diffused junction type as a later development. This type has certain advantages including elimination of short circuit instability.

A rectifier is a medium through which an incoming alternating current comes out as a direct current. In effect, it acts as a one-way valve in which the current slips through with almost no restriction but where the backward flow meets with great resistance. Germanium is said to rectify with very high efficiency— close to 99% as compared with 80 to 85% efficiency for selenium.

Where are these diodes, transistors and rectifiers used? All the late model television sets have had certain tubes replaced with transistors. Likewise, computers, telemetering equipment, studio program amplifiers, remote control equipment, now use them. In hearing aids, great reduction in battery costs have been achieved and the decrease in size has increased the demand for these aids. Transistors have made the coat pocket radio a reality. Huge digital computers as large as a room have been scaled down to desk size by the replacement of many vacuum tubes by transistors. Transistor phonographs are now on the market.

Telephone equipment has been improved in that amplifiers can now be built into phones, giving better sound quality. Line repeater amplifiers may make radical changes in equipment. Of course, in the military field, size and reliability are very important in such applications as radar, missiles, communications, aircraft radios and aircraft control systems.

Sales volume of semi-conductor devices reached about $30-million in 1955 with a total of almost 24-million units produced. For 1956, the number of transistors manufactured should jump from 3½-million to 10- or 11-million. And in 1957 this figure might easily double, according to *Electronics*, a leading publication in the field. By 1965 the transistor business "should be well established at 400-million units annually."

Growth of diode use may not be as spectacular, but by 1965, production could possibly be at the 100-million mark.

Outside the electronic field, germanium rectifiers are now being used in such industries as electro chemicals, electroplating, arc furnaces, battery charging, anodizing, sintering furnaces, electrolytic tinning, power

Who Produces Germanium?

Eagle Picher Co.
American Zinc Co.
Sylvania Electric Products Inc.
Saratoga Laboratories
American Steel & Wire
National Zinc Co.
Johnson, Mathey Co. (England)
Tsumeb Corp. (Africa)
Foundieries de Zinc de las Vielle Montagne (Belgium)
Union Miniere du Haut Katanga (Africa)

plants and aircraft communications. Rectifying units of 40,000 amp are now available.

In addition to the major use of germanium by the electronic field there are some other important uses. The optical industry is making use of the property which transmits infrared radiation over broad regions of the spectrum. Applications for infrared spectroscopes and other infrared optical instruments are promising. Germanium is now used in some fluorescent lamps. Film resistors are made by depositing germanium on ceramic bodies. A gold solder containing 12% germanium (the gold-germanium eutectic) may be used in jewelry and in dental alloys. A glass of high refractory index in which germanium is substituted for silica may be used in wide angle camera lenses and in microscopes. Germanium is also used as a catalyst in the hydrogenation of coal. Germanium gives greater hardness and strength to aluminum and magnesium and improves rolling properties.

Translating the optimistic outlook of germanium's biggest market, the electronics industry, into germanium consumption is not easy. Two factors complicate the problem: (1) How big a slice of the market will be carved out by competitive semi-conductors; (2) how much increased efficiency in recovery and fabricating operation will stretch the available Ge supply?

What Materials Compete?

Germanium is only one of a number of elements known as semiconductors. Each of the semi-conductors has slightly different chemical properties and each job will have to be done by the most efficient product. Germanium is replacing some selenium in rectifiers but is unlikely to replace it all. Germanium, in turn, has some limitations and part of the rectifier field may be absorbed by silicon.

In nature, silicon is far more abundant than germanium. Processing costs are high and at this time purifying technology favors germanium. Processing of high purity silicon presents many difficult problems and silicon is still considerably less pure than germanium. Nevertheless, *Electronics* reports, "At least five companies have been investigating silicon processing techniques which will permit them to enter the market as suppliers. One, Sylvania, has succesfully developed a zinc-reduction process and expects to be producing 300 lb of high-purity silicon within three to five months. Sample quantities of 100 grams, refined by this process, are available now."

Biggest disadvantage of germanium is that it does not exhibit semi-conducting characteristics at as high temperatures as silicon. Generally speaking, germanium devices will not operate at ambient temperatures much above 100 deg C. whereas silicon devices operate at ambients above 200 deg C. In rectifying, silicon devices possess a higher back resistance for a given voltage. Silicon can handle several times more power than germanium. The power rectifier field seems to be mostly silicon and the military people are leaning towards silicon for the high temperature applications such as jet aircraft, guided missiles, etc. In transistors, however, germanium seems to be far out in front as only a very few companies are producing silicon transistors.

Silicon is today far more expensive than germanium, being quoted at around $390 a lb for impure material. It still must be refined at a considerable cost and then crystals must be grown from the purified product.

Materials other than selenium and silicon are not yet far enough along in development to figure prominently in the supply picture.

Increasing Efficiency

The second factor difficult to weigh in any prediction of future germanium consumption is the opportunity to increase efficiency of recovery and production techniques.

One of the big headaches in the germanium industry has been scrap loss. Improved techniques have cut down this loss from over 50% to nearer 35% and one company has reported being able to cut the figure to 18% at times. This scrap originates as metallic scrap from the dicing operation of the germanium bar. There is also some sludge, containing ceramics. Portions of the heavily doped areas of germanium which are not used in the final product are likewise returned for treatment and recovery of Ge.

Many people in the industry feel that sooner or later this problem will be considerably reduced and that the savings will stretch the available Ge supply. This was an important factor and was considered in various estimates of future consumption reported to *E&MJ* editors.

Efficiency in fabrication is also apparent in establishment of production techniques as germanium fabrication leaves what one operator described as "the cook book" stage.

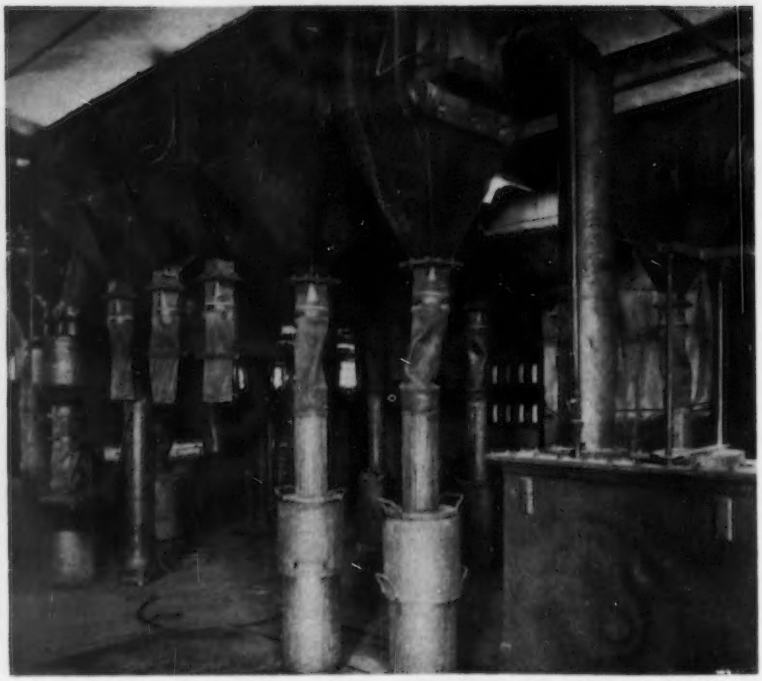
Transistor prices which probably vary from over $50 to under $3, for example, are under scrutiny of the manufacturers who are aiming for a price under $2 with improved production methods.

(*Continued on p 204*)

Who Buys Semi-Conductor Materials?

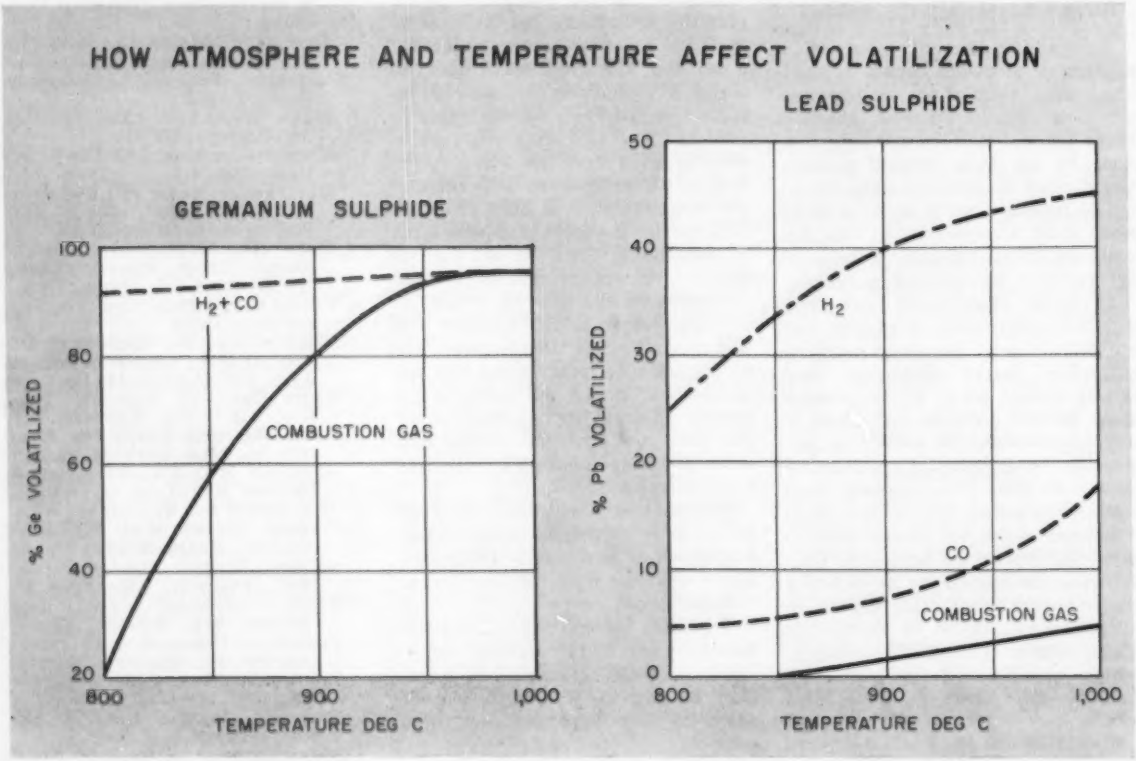
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N.Y.
Arco Transformer & Electric Co., 1602 S. Hanna, Fort Wayne, Ind.
Berkshire Laboratories, 580 Bank Village, Greenville, N.H.
Bomac Laboratories, Inc., Beverly, Massachusetts
CBS - Hytron Div., Columbia Broadcasting System, Danvers, Mass.
Federal Telecommunication Labs Div. Int. Tel&Tel, 500 Washington Ave., Nutley, N.J.
Federal Telephone & Radio Co. Div., IT&T, 88 Kingsland Rd., Clifton, N.J.
Forest Electric Co., 7216 Circle Drive, Forest Park, Ill.
Gahagan Inc., 11 West 4th St., Pittsburgh, Pa.
General Electric Co., Semiconductor Products Dept., Electronics Park, Syracuse, N.Y.
General Transistor Corp., 95-18 Sutphin Blvd., Jamaica 35, N.Y.
Germanium Products Corp., 26 Cornelison Ave., Jersey City 4.
Haydu Brothers, P. O. Box 1226, Plainfield, New Jersey
Hermetic Seal Transformer Co., 555 North 5th St., Garland, Tex.
Hughes Aircraft Co., Culver City, Calif.
Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.
International Electronics Corp., 81 Spring St., New York 12
International Rectifier Corp., 1521 E. Grand, El Segundo, Cal.
International Resistance Co., 401 North Broad St., Philadelphia 8.
Kemtron Electron Products Inc., 5 Prince Place, Newbury Port, Mass.
Keystone Products Co., 904-6 23rd St., Union City, N.J.
Lansdale Tube Co., Lansdale, Pennsylvania
Linear Equipment Labs, 380 Oak St., Copiague, N.Y.
Mansol Ceramics, 140 Little St., Belleville, N.J.
Minneapolis Honeywell Regulator Co., Transistor Div., 2753 Fourth Ave., Minneapolis 8.
Mar Velco Electronics
National Union Electric Corp., 350 Scotland Rd., Orange, N.J.
Pacific Semi Conductors Inc., Culver City, Calif.
Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.
Radio Corp. of America, Tube Div., 415 S. 5th, Harrison, N.J.
Radio Receptor Corp., 251 West 19th St., New York 11, N.Y.
Raytheon Mfg. Co., Receiving & Cathode Ray Tube Operations, 55 Chapel St., Newton 58, Mass.
Sprague Electric Co., 125 Marshall St., North Adams, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19.
Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.
Transistor Products, Inc., 241-57 Crescent St., Waltham, Mass.
Transitron Electronics, 4030407 Main St., Melrose 76, Mass.
Tung-Sol Electric Inc., 95 8th Ave., Newark 4, N. J.
Westinghouse Electric Corp., Electronic Tube, Elmira, N.Y.

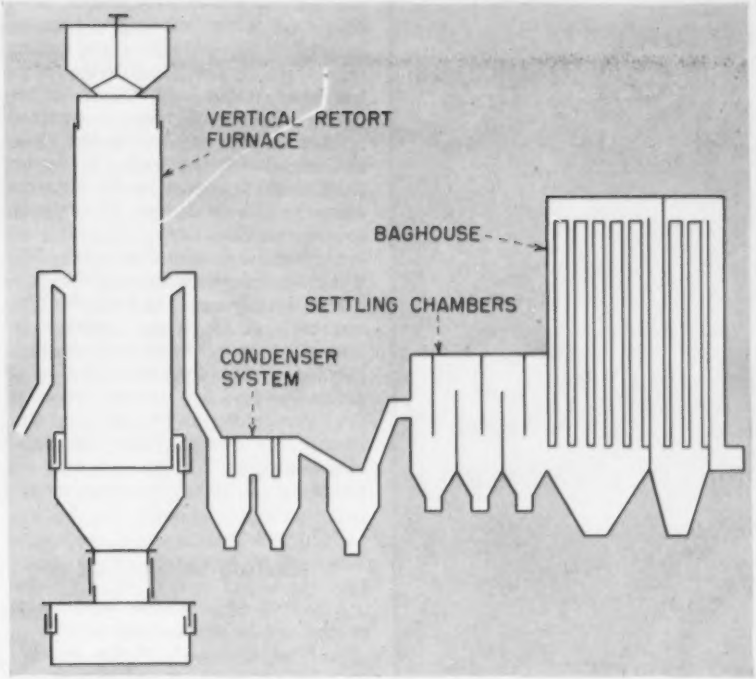
RETORT FURNACE volatilizes germanium and arsenic sulfides.



SETTLING CHAMBERS collect sulfide fumes after condensation in nonoxidizing atmosphere. Re-roasting in oxidizing atmosphere will eliminate arsenic trioxide.

How Two Big Newcomers Will





SULFIDE SUBLIMATION PROCESS is carried out in equipment shown here schematically. Excessive volatilization of lead must be avoided to prevent Ge dilution.

Produce Germanium

RECENTLY TWO NEW PRODUCERS have entered the world germanium market, shooting for production that may soon displace the Tri-State ores of the United States as the top source of germanium. The producers are Tsumeb Corp., Ltd. and Union Miniere du Haut Katanga. Both companies are recovering important quantities of germanium from mining operations in Africa and are shipping up-graded products to Belgium for further purification and the production of marketable oxide and metal.

For Tsumeb's African Concentrates— Sulfide Sublimation in Belgium

GERMANIUM OCCURS in Tsumeb ores in the minerals germanite and renierite intimately associated with tennantite, galena, sphalerite and dolomite. The microtextural relationships are such that grinding to 20 microns or finer would be required to liberate the bulk of the germanium minerals. Concentration of germanite and renierite into an enriched froth product by means of selective flotation is illustrated in a simplified flow diagram showing the origin of germanium concentrate, given in a preceding section of this issue. Because of the microtextural relationships, it is not possible to produce a really high grade froth product and normal concentrate usually runs 0.2 to 0.4% Ge, the lower grade products yielding the greater recovery. Market considerations and processing costs will no doubt dictate the most economically advantageous grade.

Early Methods of Extraction

Methods employed by early investigators to isolate and recover germanium were based upon the high volatility of germanium tetrachloride in hydrochloric acid solutions. Relatively high grade sulfide ores and low grade zinc plant residues were treated by distillation in hydrochloric acid to obtain germanium tetrachloride in the distillate from which it was subsequently recovered as the dioxide by hydrolysis in water. Direct chlorination of dry ore followed by fractional distillation of the anhydrous chlorides and subsequent hydrolysis of the distillate was also applied.

Other methods included digestion in hot 50% caustic solution followed by acidification with sulfuric and nitric acids and ultimate neutralization with ammonia to precipitate germanium and gallium. In 1935, Johnson, Foster, and Kraus reported on a method for extracting germanium from a sulfide ore wherein the ore was heated to 800° C under dry, oxygen-free nitrogen to drive off arsenic sulfide and sulfur. Residue was then treated under ammonia gas at 825° C to volatilize germanous sulfide.

Recently, Kenworthy and Absalon of the U. S. Bureau of Mines have shown that germanium, along with other volatile impurities, can be removed from Tri-State concentrates by heating to 900-1000° C under neutral or reducing atmospheres. More than 90% of the germanium was removed from the concentrate in three hours at 1000° C, but because of low (0.-012%) germanium content of the original concentrate, and because of simultaneous sublimation of sulfides of cadmium, lead, and zinc, Ge content of condensate was less than 1%.

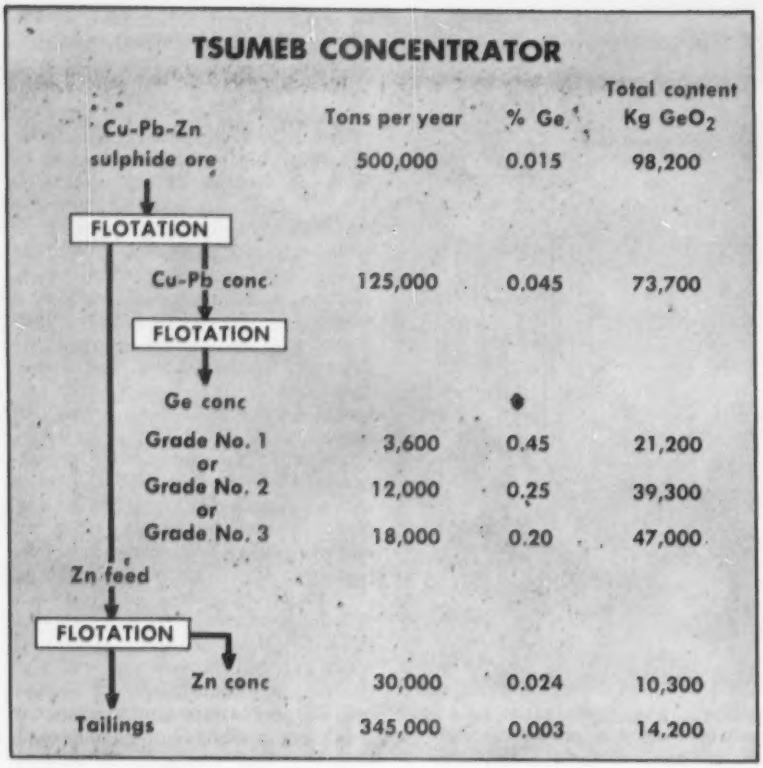
Commercial Production

While a number of different commercial techniques are employed now to recover germanium from ores and residues and to pre-concentrate the element into higher grade products, the process universally used for final purification and ultimate production of electronically pure GeO_2 employs the classical technique of tetrachloride distillation.

Commercial methods of recovery in the U. S. and Britain have been adequately reviewed in the literature in recent years. Source materials for most of the germanium produced in the U. S. are by-products from smelting Tri-State zinc ores, and this metal (oxide) has supplied most of domestic industry's needs up to the present time.

In Britain, recovery from producer-gas flue dusts is employed to free that country from a heavy dependence upon U. S. sources for germanium metal.

In Belgium, the Societe Generale Metallurgique de Hoboken (SGMH) has been instrumental in bringing new oxide to the market at an early date by using existing facilities in the Olen radium leaching plant. Tsumeb Ge concentrates and Lubumbashi flue dust were treated by a wet process in this plant, and while this process is not the final answer for treatment of either of these materials, it did fill the gap for



I—Concentration of Germanium by Sulfide Sublimation

(American Cyanamid Preliminary Testwork)

Concentrate Analysis

Ge	0.25%	As	7.5
Pb	25.0	S	22.2
Cu	27.8	Fe	2.3
Zn	7.92	Insol	0.76

Product	% Wt.	Assay % Ge	As	Pb	Distribution % Ge	As	Pb
Ge Flot. Conc.	100.00	0.25	7.5	26.0	100.0	100.0	100.0
Oxide Residue	2.7	8.50	3.2	55.5	91.5	1.1	5.7
Arsenic Fume	9.7	0.005	75.0	0.15	0.2	97.2	0.1
Sulfide Calcine	85.0	0.024	0.15	28.8	8.3	1.7	94.2

immediate germanium production pending the development of more suitable processes tailored to the individual needs of the raw materials.

In the wet process, Tsumeb concentrate is roasted under oxidizing conditions in a hearth furnace in a manner to render 90% of the Ge soluble in subsequent leaching operations. Calcine is leached in two stages with sulfuric acid, the leach liquor from the second stage being advanced to meet fresh calcine in stage one. Acid concentration of second stage liquor is 50 gm per liter and this drops to 5 to 10 gm per liter after passing through stage one.

Pregnant solution containing 5 to 6 gm Ge per liter is evaporated to about a 10 fold increase in concentration and cooled while being strongly agitated. The resultant thick slurry is then introduced to the primary unit for distillation of $GeCl_4$.

The wet process is simple and the equipment used conventional, but certain disadvantages in recovery and cost prompted Tsumeb in 1952 to initiate a research program aimed at the development of a process better suited to the treatment of an enriched germanium flotation concentrate. This program was undertaken at the laboratories of American Cyanamid Co. in Stamford, Conn., Battelle Memorial Institute in Columbus, Ohio, Tsumeb in S. W. Africa, and Newmont Exploration, Ltd., in Grass Valley, Calif.

Three processes were developed and piloted on a small scale. Two of these utilized extraction with caustic soda by means of (a) leaching in pressure vessels, or (b) pelletizing and baking on a traveling belt. The third process employed sulfide sublimation for recovery of germanium into an enriched residue suitable as feed for the tetrachloride distillation units. It is this process which appears to be the most attractive for treatment of Tsumeb concentrate in quantity.

During the development years, SG-MH independently undertook the problem of developing a "best" method for extraction of Ge from Tsumeb concentrate on a toll basis and returning purified GeO_2 for marketing. The process evolved has become known as the "Vertical Retort Process" and represents an outstandingly successful contribution to the application of the principles of sulfide sublimation for Ge recovery.

Sulfide Sublimation

Elements of a sulfide sublimation process can be summarized as follows:

1. Heat treatment of the concentrate under neutral or reducing conditions and at atmospheric pressure to volatilize germanium and arsenic sulfides. Control of temperature to minimize loss of PbS.
2. Condensation and collection of the sulfide fume in a non-oxidizing atmosphere.
3. Re-roasting of the condensed sulfide fume under oxidizing conditions to eliminate arsenic tri-oxide.
4. Final purification of the enriched oxide residue and production of electronically pure GeO_2 by means of conventional tetrachloride distillation and hydrolysis of the distillate.

Of the materials present in the Tsumeb germanium flotation concentrate, it can be expected that under the conditions required for sulfide sublimation arsenic will be more or less completely eliminated with the germanium, and that PbS will be volatilized to some extent depending upon temperature and certain other operating conditions.

Although the arsenic content of Tsumeb concentrate is many times higher than that of germanium, its simultaneous volatilization with germanium is not particularly troublesome because the sulfide sublimate can be re-roasted under oxidizing conditions to eliminate the volatile trioxide of arsenic, leaving the non-volatile germanium dioxide in an enriched residue. Excessive volatilization of PbS, however, is to be avoided not only because it represents a diluent in the subsequently produced oxide residue, but also because it is a real loss of valuable metal from the so-called sulfide calcine which is ultimately dis-

posed of to a smelter for its lead and copper content.

Curves on page 78 show effects of hydrogen carbon monoxide, and neutral combustion gas atmospheres on the volatilization of germanium and lead sulfides. At the temperatures indicated, approximately 90% arsenic is eliminated at 800° C and 96 to 98% at 1000° C. Strong reducing gases favor markedly the volatilization of germanium at low temperatures, presumably because of reduction to the easily volatilizable germanous sulfide. At 800° C, only 20% of the germanium is volatilized in a neutral atmosphere, while with hydrogen or carbon monoxide, 90 to 93% is eliminated. At higher temperatures, however, the percentage elimination of germanium is uniformly high and constant irrespective of the atmosphere.

Lead also exhibits a marked tendency toward increased volatilization under strong reducing atmospheres, but fortunately at a temperature of about 900° C and under a carbon monoxide atmosphere, lead loss is not severe, while germanium volatilization is in an acceptable range.

Fume Recovery

Condensation and recovery of a sulfide fume presents some difficulties, particularly when dealing with a finely divided arsenical sulfide. Under the conditions for sublimation, however, the arsenic sulfide reacts with the carbon monoxide in the carrier gas to yield arsenic metal and carbonyl sulfide, COS. The arsenic metal is rather easily condensed and is better collected than would be the case for a finely divided sulfide. The carbonyl sulfide gas can be burned at the exit from the condensers to CO_2 and SO_2.

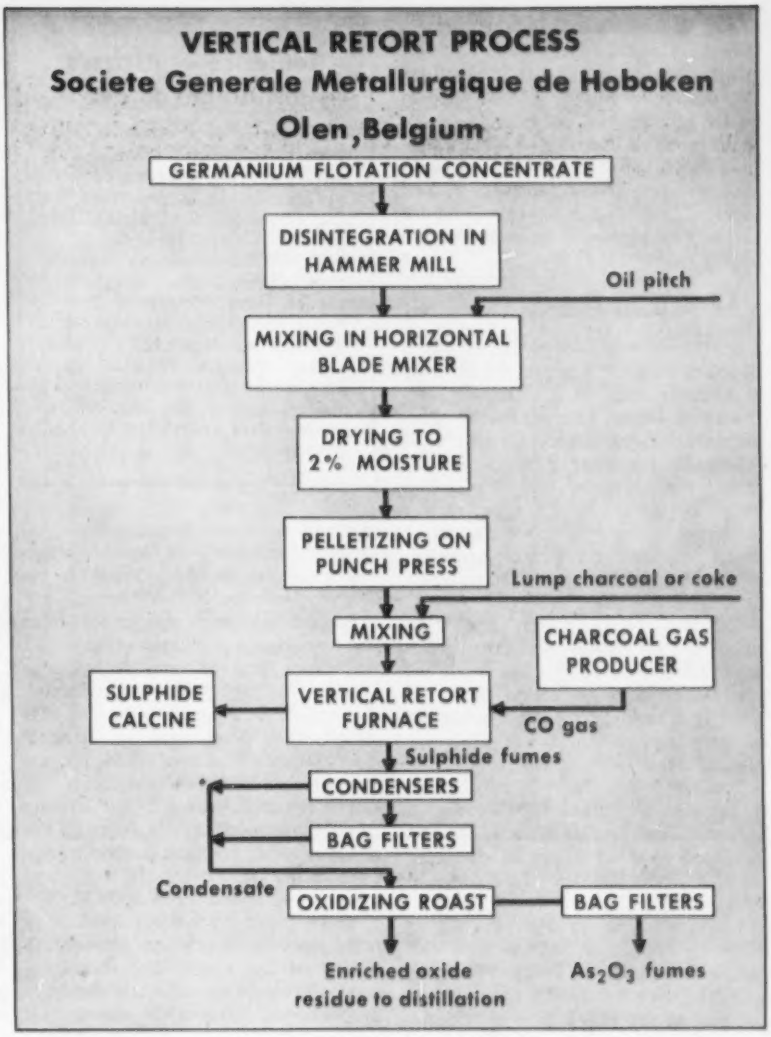
As an alternative to condensation and collection in reducing atmosphere, the fume can be ignited and burned in air to form the corresponding oxides of the various metals present. Ignition and burning can take place at any convenient point after the fume has left the furnace and is easily accomplished in an auxiliary "Dutch oven" where a small flame initiates combustion and insures that all fume is oxidized as completely as possible. The oxidized fume is then cooled and collected in a bag filter. For either sulfide condensation or ignition to oxides, resultant products are collected and re-roasted under oxidizing conditions to drive off arsenic trioxide. Germanium dioxide is left behind in the so-called "oxide residue" together with some basic lead sulfate and minor amounts of other metal oxides.

Table I shows the metallurgical results obtained on Tsumeb germanium flotation concentrate when treated by sulfide sublimation. Over 90% of the germanium contained in the flotation concentrate is recovered in an enriched product containing 8½% Ge. This material is a suitable feed for the tetrachloride distillation stills.

Tsumeb germanium flotation concentrate contains a considerable proportion of both copper and lead sulfides. In heating the concentrate to the temperatures required for reaction, a low melting point eutectic is formed between these sulfides, and unless the eutectic formation is controlled, the charge will stick in the furnace.

At first it was believed that the more or less easily fusible nature of the concentrate would impose severe limitations on the type of equipment in which the sublimation reaction could be carried out. For the sublimation process to be really attractive, the physical nature of the charge must be altered in such manner as to overcome the deleterious effects attendant upon fusion. This problem was solved by the simple expedient of admixing with the concentrate, a small proportion of carbonaceous material. Finely pulverized coal, coke, peat, or sawdust are all effective in helping to control the formation of the low melting copper-lead eutectic. Liquid hydrocarbons and still residues are also effective. The residual carbon in these additives prevents coalescence of globules of fused matte and it is possible to carry the reaction to the desired 900° C or slightly above without danger of sticking the charge in the furnace.

The Olen installation of SGMH might be described as a combination pilot and commercial plant. It is a pilot plant insofar as it has been used to determine many of the process factors required for successful operations. While tonnage treated amounts to only about 1000 kilos of concentrate per day, the annual production of



GeO_2 is significant in the present market. Continuous operation of this plant since May 1954 fully confirms the economic success of the vertical retort process and provides basis for management's decision to build a new plant with capacity of 150 tons concentrate per month for an annual yield of 8000 kg electronically pure GeO_2. This plant will be in production in September of 1956.

Plant Flowsheet

In the Olen pilot-commercial plant flotation concentrates are put through a hammer mill to disintegrate any cemented lumps formed during shipment of the material from South West Africa to Belgium. Product is then mixed with 10% by weight oil pitch in a horizontal blade type mixer; discharge is dried to about 2% moisture; pelletized on a simple punch type press; and the pellets are screened to remove any fines.

Oil pitch is the preferred additive since it imparts a desirable green strength to the pellet as well as provides fusion protection. The oil pitch is a residue from the treatment of petroleum oil and has no commercial value in Belgium.

Present pellet shape is cylindrical, 3 cm dia. by 2 cm high. Research indicates that pellet size might be increased to 5 to 6 cm in diameter without affecting the rate of Ge sublimation.

Lump charcoal to 4% or coke to 10% by weight, is mixed with the pellets immediately before charging to the furnace. Lump size ranges from the size of the pellets to 4 or 5 times pellet diameter. Function of the charcoal or coke added at this point is to "fluff" the charge to maintain porosity of the stock in the furnace and cut down pellet-to-pellet contact. This is a distinct aid in controlling sticking.

Vertical Retort Furnace

The vertical retort furnace (See drawing) is a muffle-fired furnace with the retort itself constructed from standard carbofrax brick. The retort in the reaction zone has a cross section of 23 x 58 cm and a volume of 871. Pellets are charged intermittently at the top through a sealed charging device and travel downward through the reaction zone where arsenic and germanium sulfides are volatilized. 30% carbon monoxide gas from a charcoal producer is metered into the retort at top and bottom and the volatilized sulfides are removed from the reaction zone and enter the condensers through the gas passages. Germanium laden fume leaves the retort at a point of maximum temperature to avoid premature condensation. Average gas composition from the charcoal producer is 28 - 30% CO, 1 - 2% H_2, balance N_2.

Sulfide calcine is discharged from the furnace via a reciprocating feeder and drops into a water sealed container. The rubber sleeve connecting the calcine container and furnace is closed when containers are changed. A similar closure is used on the collecting pots beneath the condensers.

The retort is heated by oil burners in combustion chambers opposite the reaction zone. Average reaction zone temperature is 870 to 980° C and stack gas temperature is 700° C.

The major arsenic elimination takes place in the upper or pre-heating section of the retort. The re-heating zone and reaction zone are therefore proportioned to provide the proper residence time in each. At 600° C, the pellets undergo a temporary softening effect thought to be related to the rate of removal of arsenic sulfide. Satisfactory operation is usually obtained when the pellets have a strength of at least 4 to 6 kg per sq. cm.

To avoid loss of Ge fume, the Olen plant checks for cracks in the retort wall by bubbling a sample of stack gas through nitric acid to absorb any Ge which may be present. Periodic analyses reveal any abnormally large losses. In one year of operation only one crack has developed and this was traced to an improper design of brickwork. The carbofrax brick have otherwise proven to be very satisfactory and show no absorption or penetration by fume.

To check on the progress of the reaction in the retort, a sample of condenser gas is bubbled through water to decompose the COS and an analysis is then made for the resultant CO_2 content. CO_2 is proportional to COS and a low COS value indicates incomplete reaction. By establishing certain standards related to the arsenic content of the concentrate and the quantity of carbon monoxide gas used, the operator has a prompt check on the operation of the retort.

Fume from the retort contains GeS, As metal, PbS, minor ZnS, unreacted CO and COS gas from the reaction between arsenic sulfide and CO. Fume has been collected in two ways, (1) condensation in water cooled condensers with passage of any unsettled fume through bag filters, and (2) burning (oxidation) of fume as it leaves the furnace and collection of the resultant mixed oxide fume in settling chambers and bag filters. The first method is preferred because the final residues produced are higher in grade with respect to Ge. Non-oxide fume is also much more dense and easier to collect and handle without danger of mechanical loss of Ge. The one drawback is danger of explosions in the condensers because of inadvertent atmospheric leakage. Adequate safeguards in the form of pressure release mechanisms must be provided. Exit gases from the condenser-bag filter train must also be burned because of their toxicity. Another point of difference in favor of collection of non-oxide fume is that with this method 80% of the germanium is recovered in the condensers and only 20% in the bag filters. With oxide fume, the distribution is reversed; 80% of the Ge is found in the bag house and 20% in the primary settling chambers. The danger of Ge loss through rupture of the filter is therefore much greater with oxide fume.

The collected fume from the condensers and bag house is given an oxidizing roast in an electrically heated muffle furnace at 550° C to drive off arsenic trioxide and to oxidize sulfur to SO_2 or sulfate. The fume is spread in shallow layers on pans carried in a rack in order to obtain adequate surface exposure for oxidation. Volatilized arsenic trioxide is collected in bag filters.

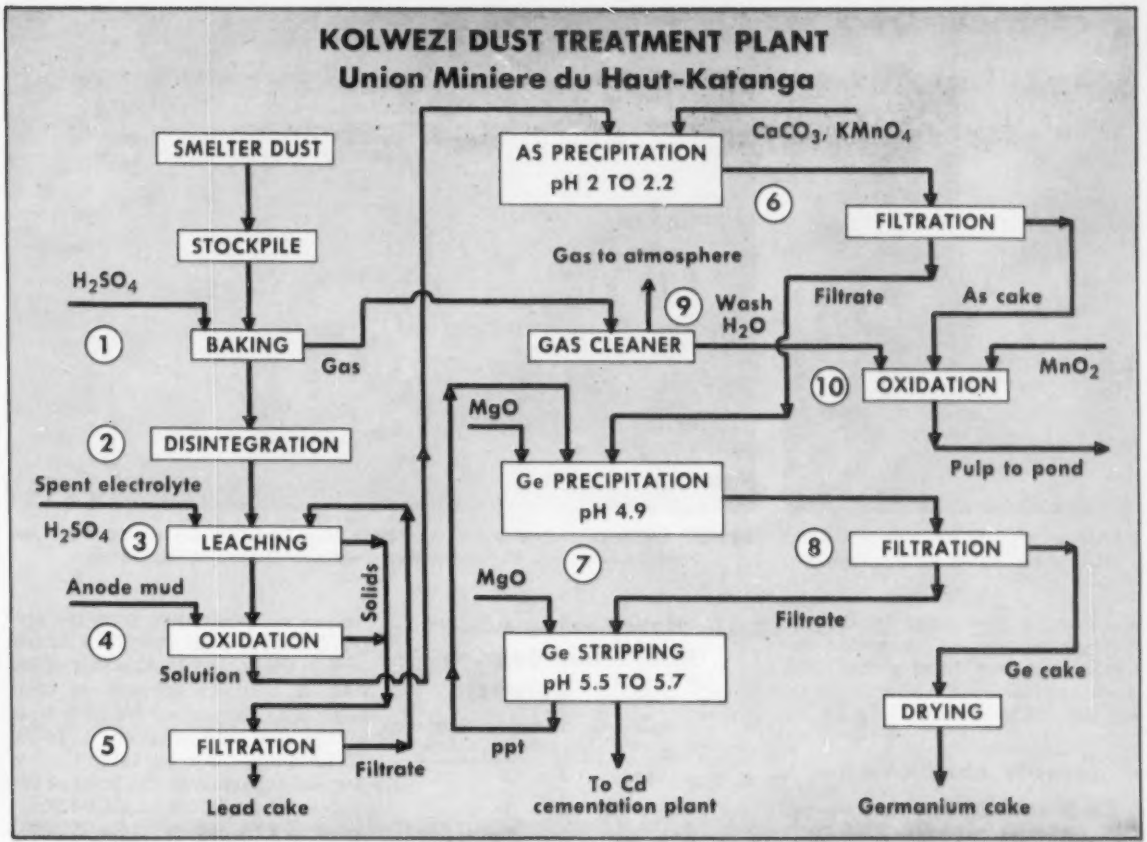
Loss of germanium in non-oxide fume collection is negligible. About 0.2 - 0.3% of the Ge in the concentrate is lost when burning to oxide at the retort prior to collection, and in either case about 0.5% escapes with the As_2O_3 in the final oxidation roast. Actual recovery of Ge in the Olen plant for the first year of operation was 90%.

A typical analysis of the oxide residue which is the end product from the retort plant is 20 - 30% GeO_2, 35 - 50% Pb, 4% As and 2% S. This material is sent to the purification plant for production of electronically pure GeO_2.

Renierite — Africa's Germanium Mineral

Renierite is a complex copper - germanium - arsenic sulphide with an average content of 7% Ge. It is described by Dr. James Murdoch of the University of California.

Isometric — minute crystals rare showing the tetrahedral aspect. Usually massive. Cleavage none. Brittle. Hardness 4.5. Specific gravity 43±. Color orange bronze. Polished surface shows anisotropic turn lamellas. Lower Ge, higher Fe content than germanite. Strongly magnetic.



LEGEND

1. Baking is done in 3½-ft diameter by 72-ft long rotary kiln; 6-in. acid proof brick lining. 450 to 500 deg C for 4 hr
2. Baked material is disintegrated in hammer mill
3. Leaching accomplished in 1500 cu ft lead lined agitators 20,000 to 22,000 lb batches at 2½ to 1 pulp density, 1½ hr
4. Solution from leach is oxidized by agitating with MnO_2 anode mud and $KMnO_4$ in 1500 cu ft tanks for 1½ hr at 45 deg C
5. Settled solids are filtered on two presses for recovery of lead cake
6. Arsenic is precipitated by adding crushed limestone and precipitate is removed on two filter presses
7. Addition of MgO precipitates copper hydroxide which carries germanium with it. Low grade precipitate is returned to circuit
8. High grade Ge precipitate is filtered and dried on Lowden drier
9. Waste gas from kiln is cleaned in Anthony Venturi scrubber
10. Water from scrubber is combined with arsenic cake, oxidized with MnO_2 ore in two pachuca tanks at 45 to 50 deg C, and pumped to tailing pond

Union Miniere du Haut-Katanga Up-Grades Kolwezi Smelter Dust

SELECTIVE FLOTATION is used to treat copper-zinc ores of the Kipushi Mine, near Elisabethville in Katanga, Belgian Congo.

Copper concentrates from the flotation plant are smelted at the Lubumbashi smelter of the Union Miniere du Haut-Katanga; zinc concentrates are sent in part to the electrolytic zinc plant owned and operated by the "Societe Metallurgique du Katanga" at Kolwezi, Katanga, and the balance is exported to Belgium.

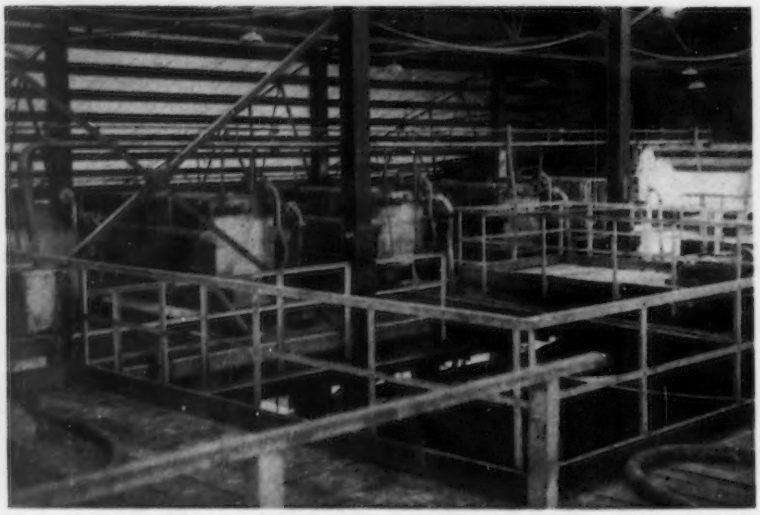
Germanium occurs in certain ores of the mine as the mineral renierite. In flotation, the mineral preferentially follows the copper so that concentrates at the smelter contain the bulk of the germanium in the ore.

Operations at the smelter have been adequately described in recent technical publications. After sintering on Dwight-Lloyd machines, the concentrate is smelted to matte in water-jacketed furnaces, and the matte converted to blister copper. Many years ago, when more zinky ore was treated, a dust collecting plant was installed for recovery of dust and fume from waste gases. Waste gas is first passed through a Buell type cyclone collector where the coarsest dust, containing the major part of the copper lost during blowing, is recovered. The cyclone is followed by a bag filter for collection of fume.

The fume or "dust," is of interest because of its zinc and cadmium content and years ago the recovery of these metals was proposed in conjunction with a project for the erection of an electrolytic zinc plant. It was known that the dust contained an appreciable amount of germanium, in addition to some 7% of arsenic, both of which would be troublesome in the zinc plant.

When interest in germanium arose in the electronics industries, the question of dust treatment was reviewed

BAKING with H_2SO_4 removes about 90% of the initial arsenic content.



FILTER PRESSES recover a cake containing from 8 to 10% Ge after precipitation from leaching step. Material is then dried and shipped to refining plant.

and research was started for the separate recovery of the germanium content of the blast furnace dust. This work resulted in the installation of the Kolwezi dust treatment plant.

Capacity and Production

The Kolwezi flue dust plant was put into operation in early 1955 at a monthly design capacity of 650 short tons of dry dust. The annual rate of precipitate production is of the order of 240 short tons of dry precipitates assaying 8 to 10% Ge and containing 25,000 to 31,000 kg GeO_2.

Average over-all recovery for the process is approximately 75% which breaks down to 92% during baking and 80% or slightly better in leaching and precipitation.

Operations at the dust treatment plant may be summarized as follows:

(1) Baking with sulfuric acid.

(2) Acid leaching of the baked dust.

(3) Arsenic oxidation followed by its precipitation.

(4) Germanium precipitation.

Baking

After moistening to nearly 20% H_2O, the dust recovered from the bags is stored at the Lubumbashi smelter in uncovered pits, from where it is sent to the Kolwezi plant. This material has undergone some sulfatizing action and contains variable amounts of agglomerated lumps which are broken to about 10 mesh by passage through a Carr-type disintegrator.

Research on the baking process indicated that about 90% of the initial arsenic content of the dust could be eliminated in the baking operation preceding leaching, and reference to Table I shows that plant operating results have confirmed this expectation. Feed to the baking kiln is given a pasty consistency of 25 to 30% moisture while mixing with water and sulfuric acid. Mixing is done in the feeding screw of the kiln, addition of sulfuric acid from 0.6 to 1.0 part by weight of the dust.

I—How Baking Affects Germanium Bearing Dust at Kolwezi

	Crude dust	Baked dust	Baking loss
Ge	0.360%	0.285%	8%
Zn	28. %	22.5 %	6%
Cd	3. %	2.64 %	5%
Pb	25. %	20.3 %	3%
Cu	1.5 %	1.2 %	
As	7.3 %	0.7 %	88 to 90%

Kiln capacity is 1700 to 1800 lb dry dust per hour. Average analysis of the baked dust in Table I gives an idea of the losses occurring during this phase of the process.

Gases escaping from the kiln at 250° C are washed in a Venturi scrubber before being rejected. The calcines enter a hammer-mill to eliminate the lumps of agglomerated particles and are then stored in bins ahead of the wet treatment.

Leaching

At the beginning of a leaching operation, the agitators are filled with acid solution which is a mixture of partially depleted solution from cadmium electrolysis and wash water from the several filtrations made during the further steps of the process. Final acidity of the solution is 10-15 gpl and its composition at the end of leaching is as follows (all in gpl). Zn 110-130; Cd 15-20; As 2.5-4; Ge 1.4-2; Cu 2-4. Average extraction to this point in the process is: Zn 98-99%; Cd 94-96%; As 80-85%; Ge 90-95%; Cu 75-90%; Fe 80-78%.

After leaching the pulp is settled in the agitator tank and the clear solution is pumped forward to the next step in the process by a suspended acid resisting pump. Thickened pulp is received in a storage tank equipped with an agitator and filtered on two filter presses. Residual tailing of this leaching operation is mainly lead sulfate of the following approximate composition:

Pb	Zn	Cd	Cu	As	GeO
61.35%	1.28%	0.5%	0.83%	0.39%	0.05%

Oxidation of Pregnant Solution

Clear solution from the leaching agitators contains considerable arsenic which must be eliminated before germanium precipitation. Preliminary research indicated that without oxidation of the solution, arsenic could be precipitated at pH 4.5, but selectivity against Ge was not good. Low arsenic solution with an acceptable loss of germanium could only be obtained after preoxidation of the pregnant liquor. When working with oxidized solutions at pH 2.2-2.4, 80% of the residual arsenic is eliminated with a loss of only 3 to 5% of the germanium. Little zinc and cadmium are entrained in the precipitate.

MnO_2 anode mud from the elec-

trolytic plant is used at the beginning of the oxidation step and oxidation is carried to completion with a supplementary addition of potassium permanganate. During the oxidation step itself there is a partial precipitation of arsenic, the concentration of this element falling to 1.5-2 gpl.

In this step of the process the solution is brought to pH 2.3-2.4 by adding crushed limestone over a period of 3 hours. Pulp is filtered and washed on two filter-presses and purified solution is ready for the germanium precipitation section. Arsenic content of the solution is as low as 0.4 gpl and iron content is less than 100 mgpl. Copper content, however, is in the range 3 to 5 gpl.

Germanium precipitation is done in two steps. In the first, only part of the Ge is recovered since this leads to greater selectivity and the production of a suitably high grade product. A lower grade precipitate is then made by stripping residual solutions with the precipitate being returned to the first step as indicated on the flowsheet. Adjustment of pH in these operations is made by pure magnesia to minimize the contamination of the product by insoluble salts as would be the case if using lime.

Germanium is eliminated in most electrolytic zinc plants when precipitating iron as iron hydroxide, the hydroxide having an acute absorption capacity for germanium as well for the arsenic.

In the present process germanium is entrained by the absorbing action of the copper hydrate, sufficient copper being left in the solutions entering the degermanisation vessels.

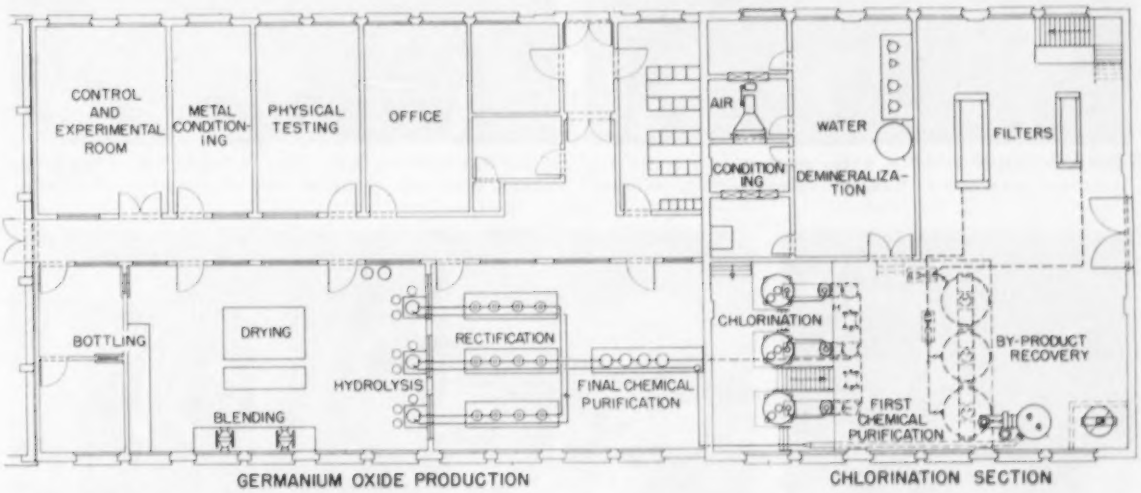
A germanium cake of the following analysis is recovered on the filter press:

Ge	Zn	Cd	Cu	As
8-10%	15-20%	1-1.5%	10-18%	0.7-2%

This material is dried and shipped to the Olen refining plant of the Sociate Generale Metallurgique de Hoboken in Belgium where electronically pure GeO_2 and metallic Ge are produced.

The low grade germanium precipitate is thickened and, without filtration, is returned to the first precipitation step while the overflow goes to the cadmium cementation section of the electrolytic zinc plant. These final solutions have approximately the following analysis:

←gpl→		←mgpl→	
Zn	Cd	As	Ge
110-120	12-18	1-3	15-30



SGMH's OLEN PLANT separates chlorination and oxide production. Metal production takes place in a room off oxide rooms.

How Germanium Oxide and Metal— Are Produced at Hoboken

AT THE OLEN (Belgium) plant, refined germanium oxide and germanium metal are produced by Societe Generale Metallurgique de Hoboken (SGMH) for the account of Union Miniere from materials originating in the Belgian Congo. It was not until 1952 that Union Miniere became interested in recovering and marketing a germanium product; events have moved rather rapidly since that time.

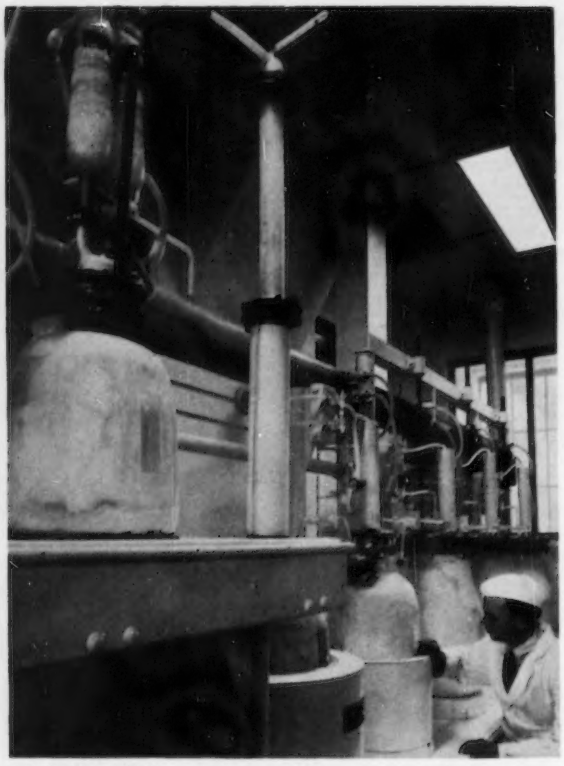
In August of 1953, the first small pilot plant with a monthly capacity of 25 Kg refined GeO_2 was in operation and in September 1954 the first commercial unit with an annual output of 8000 to 9000 Kg GeO_2 was placed on stream. To meet ever increasing demand, three additional commercial refining units are now being built and will be ready for operation in mid 1956. The new units are identical in size to the first commercial installation and will bring the overall capacity of the Olen plant to about 34,000 kg (75,000 lb.) refined GeO_2 per year. It is anticipated that one of the units will be devoted to the treatment of returned germanium scrap; the remaining three will be used for creating new production.

Tetrachloride distillation is used for production of commercial GeO_2. The elements of this process are well known. Germanium tetrachloride is distilled from hydrochloric acid solutions in the presence of chlorine; collected $GeCl_4$ is purified in a multistep process; purified $GeCl_4$ is hydrolyzed and the resulting GeO_2 is filtered, washed and dried.

At the Olen plant, a variety of raw materials is treated and the problem has been to develop suitable equipment for handling this material on a large scale while still preserving a flexibility in operations. An effort is made to maintain raw material feed of such grade that the yield is at least 30 liters $GeCl_4$ per cubic meter capacity of the primary still.

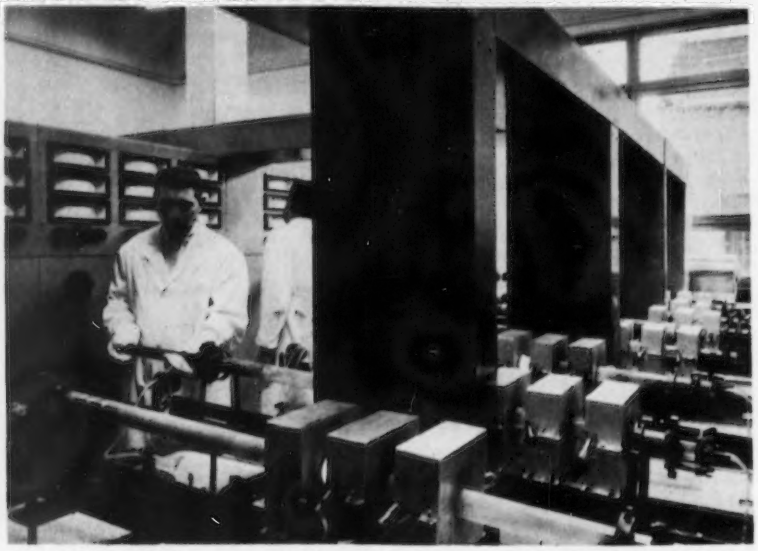
Chlorination is effected in a room isolated from the purification and ox-

CHLORINATION UNIT is where germaniferous material is mixed with concentrated HCl and various recycled solutions.



PURIFICATION of $GeCl_4$ must be carried out in equipment made from pure quartz or from special plastic materials.

HYDROLYSIS of purified $GeCl_4$ yields 20- to 25-kg batches of GeO_2.



ZONE REFINING removes last impurities from metal. Molten zone of metal is moved from one end of ingot to the other carrying the soluble impurities with it.

ide production rooms. Primary stills are steam-jacketed vitrified steel kettles of 200-l capacity. They are equipped with a mixing device and have bottom discharges. The covers have outlets for a pyrex distillation column and connections for chlorine and acid.

At the start of an operation, germaniferous material is charged into the still and mixed with concentrated HCl and various return solutions. Chlorine is introduced without heating until the solution becomes saturated with Cl_2 and $GeCl_4$ is then distilled under a small flow of chlorine.

Vapor condensation is achieved in a pyrex condenser held at —10° C with circulating brine. The condensed $GeCl_4$ is collected in pyrex flasks of 75-liter capacity equipped with mechanical stirrers where it undergoes a chemical purification before being advanced to the next step in the process.

Each still, condenser, collecting ves-

sel, and purification flask operates as an independent group. To prevent loss of $GeCl_4$ due to its high vapor pressure, every vessel containing $GeCl_4$ is connected permanently to a condenser at —10° C. As a further precaution against loss, and also to prevent contamination of the atmosphere with volatile products, all waste gas is scrubbed with sodium carbonate in a tower 1.2 meters dia. x 6.5 meters high. Spent solution from the tower is periodically returned to the cycle.

Located in the chlorination section are mechanically agitated, rubber lined precipitation tanks of 3 cu. m. capacity where various by-product solutions are treated with lime for recovery of contained Ge. Steam injection through a graphite pipe aids precipitation.

Purification

Purification of $GeCl_4$ is carried out in a separate room in the oxide production section. All of the equipment here is either fabricated from pure quartz or from special plastic materials whose purity is controlled by spectrographic analysis.

Chemical purification is a three step process carried out in sintered quartz vessels of 65 liter capacity. The inner side of the vessels is vitrified with utmost care and transparent quartz windows are set in the walls for visual control of operations. Mechanical stirrers are of P. V. C. carefully tested to insure the absence of trace elements.

After chemical purification, the $GeCl_4$ goes through a rectifying operation to remove last traces of impurities. Chemical purification is a fast operation and one group of containers is sufficient to handle the production from three primary stills. Rectification proceeds much more slowly and it is necessary to conduct this step in three parallel flow lines. The vessels used are 35-liter flasks of the same quality quartz employed through the oxide production section. Reflux columns, condensers, valves and pipes for solution flow are all transparent quartz. Gaskets, where used, are all of transparent teflon.

Hydrolysis

Hydrolysis of purified $GeCl_4$ is accomplished in a second room of the oxide section. This operation is currently conducted in batches to yield about 20 to 25 kg GeO_2, but it is intended to change to a continuous basis when the new plant goes into operation. The vessels used are 75 liter P. V. C. flasks equipped with mechanical agitators and brine jackets for maintaining a suitable temperature level. Stirring, rate of addition of $GeCl_4$, and temperature are controlled to yield a GeO_2 precipitate of uniform texture for conversion to Ge metal.

Filtration and washing of GeO_2 is carried out on Buchner filters having a capacity of approximately 3 kg wet cake. The wet cake is spread on a 300 mm dia. tray of fused silica and dried at 200° C in a metal free electric oven. All electrical connections to the oven, the vapor outlet, insulation lagging and metal supporting structure are isolated outside the workroom.

After cooling the dried cake, the GeO_2 is blended in batches of 25 kg in an abrasion resistant metal free plastic conical blender. Finished product is immediately packed in carefully washed and dried bottles for shipment.

Purity requirements of GeO_2 are extremely severe and the packing problem is of great importance. Quality of the glass or plastic containers has to be carefully checked and bottles must be absolutely tight to prevent contamination. Care taken in packing is as stringent as for high quality pharmaceutical products.

Cleanliness

Cleanliness in general operating conditions, special materials of construction, and precautions against contamination from outside sources are of extreme importance in producing GeO_2 of high purity. All working spaces where high quality GeO_2 or metal is handled are kept under a positive pressure of air. In the new plant, the air will receive a double filtration, the second stage being through an "absolute" filter with an efficiency of 99.95% down to a particle size of 0.2 to 0.5 micron. Special precautions are also taken in using only purified air for transferring of liquids in flasks.

Floors, walls, and work benches in the oxide and metal sections are covered with P. V. C. materials. Any paint used on metal parts of equipment is plastic base free from mineral pigment.

Process water used throughout the plant is produced by total demineralization in a four column ion-exchange installation. The columns are packed with, respectively: activated carbon for removal of colloids and organics, cation exchange resin, anion exchange resin, and mixed resins. Resistivity of the water produced in this system is 5 million ohms per cc.

Close supervision and training of personnel is required in order to reap the benefits of mechanical aids to absolute cleanliness. Auxiliary aids are also useful and include dining rooms, washrooms and a laundry for special care of workmens clothing which is furnished by the company.

Production of Ge Metal

Germanium metal is currently being produced in a pilot plant, but the new refinery has a complete section devoted to this type of work.

The following operations are involved in metal production:

1. Reduction of GeO_2 into ingots.
2. Segregation of the ingot into purified metal.
3. Zone refining of purified metal into metal of the highest purity.

Reduction

Reduction is accomplished by loading 1700 g of GeO^2 into a pure graphite boat and heating to 650° C under an atmosphere of cracked ammonia. Towards the end of reduction, which takes 22 hours, the temperature is raised gradually to 900° C and finally to 1100° C for one-half hour to melt the germanium. The boat and silver-grey metallic ingot are withdrawn from the furnace at 350° C after cooling under dry nitrogen.

The ingot (average weight 1150 g) is weighed and classified in accordance with local and average resistivity tests. It is then pickled for 3 minutes in a fresh acid solution containing 2% HF and 80% HNO_3, washed in double distilled water and dried.

Although this ingot is produced under very exacting conditions from highly purified GeO_2, it still contains too many impurities for transistor manufacture. Germanium is a semiconductor and its resistance to the flow of current increases as impurities are removed. Thus the stage of its purification can be measured.

Segregation

Segregation is an operation where part of the impurities are moved to one end of the ingot and chopped off. The ingot is melted in a graphite boat at 1030° C in an atmosphere of 95% N_2, 5% H_2, and then subjected to directional cooling at a rate of travel of 20 cm. per hour. The impurities, which tend to remain in the liquid phase, are thus swept to the end of the ingot last to solidify. Average and local resistivity tests show how much of the ingot to cut off (usually 10%). Any ingot having a resistivity lower than 7 ohms is put through a second stage of segregation.

After degreasing in alcohol, rinsing in ether, pickling in fresh acid, washing and drying, the ingot is ready for zone refining.

Zone Refining

Zone refining removes the last impurities from the metallic germanium

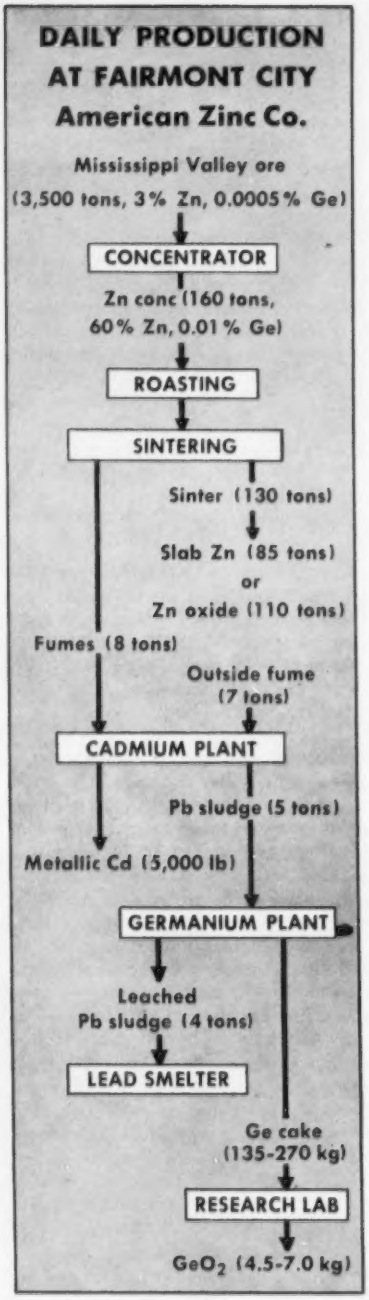
ingot. In this process, a narrow molten zone of metal is moved from one end of the ingot to the other, carrying impurities with it. Several successive passes are required in order to achieve the desired purity, and this is accomplished in a typical installation by mounting three heating elements of 80 mm width side by side with a center to center distance of 135 mm. The elements are moved at a speed of 12 cm per hour over the ingot which is carried in a graphite boat inside a quartz tube. An atmosphere of 5% H_2, 95% N_2, surrounds the ingot during zone refining. Two passes of this triple heating assembly are usually sufficient to produce metal of the required purity.

By this method, metal of either 30 ohms or 50 ohms resistivity may be produced according to the specifications imposed. After cutting off the impure portion, the ingot is degreased, pickled, washed, dried and packed in a polyethylene bag.

Specifications

The germanium market is still in its infancy and this is felt by the absence of well defined specifications agreed upon the world over. The most common specification concerns resistivity and this is an indispensable criterion for assessing the quality of metal, but it is not the only one.

Even for a simple resistivity test there is no agreed standard fixing the temperature at which the measurement is to be made, the form of the specimen or the current intensity to be applied. Matters are still more confused in the application of the "life time" test. Methods of execution vary from one plant to another and even the principle of the method itself is interpreted differently in various countries. The efforts of the A. S. T. M. in formulating standards for the specifications of germanium are well conceived and should be welcomed by both producers and users of this metal.



In the U. S., Germanium Production Must Overcome Low Grade Material

NECESSITY OF PRODUCING an oxide germanium containing less than 10 parts per million of total impurities from products of very low germanium assays makes production in the United States a particularly difficult and expensive proposition. Nevertheless a number of producers are in the field as noted in a previous section of this report. Here is how one of them, American Zinc Co., meets the challenge at its Fairmont City plant where it is producing 10 to 15 lb of GeO_2 a day.

Basic raw material of the plant is the zinc ore of the Mississippi Valley. No specific germanium minerals have been identified in these ores, and it seems probable that the germanium sulphide is present as a minor component of the zinc sulphide or cadmium sulphide minerals. When the crude ores are milled, the germanium reports in the zinc concentrates, together with the cadmium originally present in the ore. Even though the zinc concentrates contain about twenty times as much germanium as the crude ore, the assays are still very low, as is shown in the accompanying table.

District	% Ge	Pounds Ge per Ton
Tri-State (Joplin)	.006-.015	.12-.30
Wisconsin	.004-.007	.08-.14
Illinois-Kentucky	.01-.04	.20-.80
Most others	.000-.002	.00-.04

When these concentrates are roasted and sintered, most of the cadmium, germanium and lead is collected in the form of fumes and dust, and these products are treated at the cadmium plant. As is indicated in the attached flowsheet, the zinc and cadmium in the fumes are leached out with acid, and the resulting liquors (17,000 gallons per day) are treated for the recovery of these metals. The lead and germanium are filtered off as an insoluble sludge consisting principally of lead sulphate, but containing such impurities as arsenic, antimony, bismuth, tin and, of course, germanium.

Lead sludge is again leached, this time in hot strong sulphuric acid, and the germanium is extracted. A liquid-solid separation is made by countercurrent decantation, and the lead sulphate is shipped to a lead smelter. The liquors are purified to remove most of the copper, and then the germanium, cadmium, arsenic, and similar metals are precipitated from an acid solution as a sulphide cake. The latter is roasted, leached in strong sulphuric acid to remove part of the cadmium and arsenic, and sent to the distillation plant.

The final acid cake is charged to glass or glass-lined stills, where the germanium is converted to germanium tetrachloride, vaporized and then condensed. The crude germanium tetrachloride is redistilled several times to eliminate the contained arsenic and other impurities. The purified tetrachloride is hydrolyzed in cold water, yielding hydrochloric acid and germanium dioxide. The latter is filtered off, dried, and packaged for shipment..

The production of germanium oxide is rendered difficult and expensive because of the very low assays of the products treated for germanium recovery, and by the necessity of producing an oxide containing less than 10 parts per million of total impurities.

COMBINING temperature control for selective leaching and recrystallization with selective, froth flotation has produced higher quality salines at higher recoveries.

Saline beneficiation has come a long way since Charles Jeanprost first recognized the techniques demanded in the flotation of a slightly or readily soluble mineral. Professor Gaudin reviews the state of salt flotation practice and provides a broad picture of developments in the industry.

Saline Flotation: Progress and Problems Present a Challenge

A. M. GAUDIN
Professor of Mineral Dressing
Massachusetts Institute of Technology
Cambridge, Mass.

THE FLOTATION PROCESS of ore concentration was first applied to the ores of metalliferous minerals. By and large these ores are insoluble in water. Consequently the entire technique of flotation grew up around the concept that the minerals to be separated were essentially undissolved and insoluble solids. Salines, that is the crystallized mixtures of naturally-occurring highly soluble salts, were considered inappropriate materials for flotation treatment. It remained for a Frenchman, Charles Jeanprost (1), to call attention to the fallacy in the reasoning that ore dressing methods could not be applied to highly soluble materials. By using as separating medium a saturated aqueous solution of the mixture to be treated, Jeanprost recognizes that the solids, in effect, are insoluble in the medium and that appropriate flotation reagents should be capable of making a separation. This early reference is particularly directed to the treatment of crude nitrates (caliche) from northern Chile; a mixture of insoluble gangues with sodium nitrate, chloride and sulfate. Jeanprost realized the generality of his concept and directed his process not only to caliche, but also to the beneficiation of borates, sulphates and other soluble metalliferous salts.

Very shortly after this invention, work was done in Germany on flotation of slightly soluble minerals such as cryolite and gypsum (2). This developed further the idea of Jeanprost that solubility is not a bar to flotation treatment.

At about the same time a substantial step forward was taken by Nessler (3) in the laboratories of I. G. Farbenindustrie, A. G. He applied flotation to the separation of alkali-metal nitrates from ammonium chloride. Nessler's invention involves a combination of flotation with metathesis in aqueous medium. In his process the mixture of solids added to saturated liquor is in the form of the reciprocal salt pair; as compared with the form in which the solids occur when the separation is made. For example, Nessler added to a saturated liquor a mixture of ammonium nitrate and potassium chloride, which by double decomposition formed a mixture of ammonium chloride and potassium nitrate. This mixture was subsequently separated in the flotation step: ammonium chloride floating while the potassium nitrate did not float.

Nessler also found that temperature regulation was beneficial not only in making possible the re-use of the flotation reagent, but also in obtaining purer products. His temperature control consisted in heating reagent-covered ammonium chloride (thereby detaching the agent from the crystals) and dissolving the minor impurity, cooling, separating the crystals, liquor and oil; and reusing the liquor and the oil. Of course the mineral mixture to which Nessler addressed himself was not a natural saline but an artificial system. He worked under conditions in which water-insoluble impurities, usually present in natural salines, could be eliminated and in which the proportion of the separated constituents was regulated. Compared to the treatment of natural salines, the problem to which he addressed himself was relatively simple and controllable.

Earliest application of flotation treatment of natural halides came from Russia, where Pylaev (4) proposed to use flotation to purify the waste remaining after extraction of potassium chloride from sylvinite ores. This waste consists mostly of sodium chloride with minor quantities of potassium chloride and of relatively water-insolu-

ble material, such as anhydrite, gypsum and clays. Pylaev proposed to make from it large quantities of table salt and of purified industrial salt. He describes a flotation procedure which removes, as froth, calcium sulphate minerals and clays, leaving behind sodium chloride. Separation is conducted in a saturated sodium chloride brine. This brine has no solvent power for common salt, but does dissolve the minor quantities of residual potassium chloride impurity. Thus there is obtained as a tailing, a salt purified both by leaching and by flotation, and one capable of industrial or table use. Without emphasizing it, Pylaev utilized a feature of particular interest in flotation of salines; that flotation may well be supplemened by leaching.

Separation of potassium chloride from sodium chloride by floating one or the other of these halides from the mixture of the two, using a brine saturated as to both potassium and sodium chlorides is a direct application of the Jeanprost separation principle.

Practical separation in several different ways was obtained with amazing rapidity in two laboratories in the United States. One of these laboratories was the Rolla, Mo. laboratory of the U. S. Bureau of Mines where on August 4, 1934, F. D. DeVaney, J. Bruce Clemmer and S. R. B. Cooke discovered that potassium chloride could be agglomerated and/or floated from sodium chloride (5). In preliminary tests of August, 1934, they used as reagent a long-chained alkali sulphate characterized by supplemental existence of a complex polar group between the sulphate and hydrocarbon parts of the molecule.

Two Salts, Two Ways

Later, Arthur J. Weinig of Golden, Colorado, found that simple-structured long-chained alkyl sulphates would float sylvite from halite. This discovery was subsequently described in certain patents (6, 7).

Weinig also discovered that soap could be used to separate the same halides: this time floating sodium chloride from potassium chloride (8). To effect this reverse separation a suitable concentration of a lead or bismuth salt is maintained in the brine.

Claims to the effect that still another inventor, L. D. Anderson, had found out how to separate potassium chloride from sodium chloride have been made (9). Unfortunately, this reviewer has been unable to duplicate the separation claimed by Anderson; and for that matter the same difficulty has been encountered by others. As a technical contributor to engineering progress in the flotation treatment of potassium ores, we may therefore disregard Anderson's contribution while recalling those of Jeanprost, Nessler, Pylaev, DeVaney, Clemmer and Cooke and of Weinig.

As early as the mid-thirties there were at least two broad methods available for the separation of potassium chloride from sodium chloride, in which the collector was an anionic hydrocarbon-bearing salt: potassium chloride being floated through the use of a reagent having a sulphate group in the polar part of the molecule and sodium chloride being floated through a reagent having a carboxyl group in the polar part of the molecule, providing an activator such as a lead salt was added to the circuit.

To pursue this historical development still further it is interesting to note that a few years later it was found possible to float potassium chloride from sodium chloride through the use of a cationic collector such as a long-chained amine salt (10). This separation is not only more categorical than that obtainable with an alkali alkyl sulphate but it can be made with less reagent. It was soon found that this process did not work too well when the ore contains much clay. Since clay is floated by the amine, it has become usual to assume that the clay "steals" the agent from the potassium chloride.

Deslime or Depress

This difficulty is now overcome by either or both of two procedures. One of the procedures is to deslime the ore before the amine reagent is added (11); and the other is to add a suitable protective colloid or selective depressant. This addition has been made the object of several patents (12). Suitably hydrolyzed starch is an agent often used for this purpose.

In addition to applicating the Jeanprost principle to sylvinite ores, the flotation process was applied to other potassium ores such as langbeinite (13). Reagent used for langbeinite was again an alkali alkyl sulphate (Avirol 80), the potassium magnesium sulphate (langbeinite) being recovered in the froth while common salt is the principal constituent of the non-float. The operation is said to be carried out in a brine saturated with respect to sodium chloride, potassium sulphate and magnesium sulphate.

Fruitful applications of flotation have also been made to other soluble materials such as borax, boric acid and sodium sulphate. Boric acid can be floated without any reagent (14). It seems as if this extraordinary behavior can be related to the peculiar crystal structure of boric acid. This solid can be regarded as obtainable by stacking $B(OH)_3$ layers, each of which is a complete molecule. Again, it has been proposed to separate sodium sulfate from sodium chloride in a brine saturated with respect to both salts and made slightly alkaline with sodium hydroxide, using soaps and activating cations such as calcium (15). Sulfate floats while chloride does not. A brief study of the separation of water-soluble salts from each other is reported by Guyer and Perren (16).

Dissolve and Recrystallize

One of the important new problems arising in the flotation of salines has to do with the solution balance of the system. When dealing with an insoluble ore, all that has to be done to the concentrate and tailing is to separate them from the water, or, more accurately speaking, from the very dilute solution in which they are suspended. This solution being discarded or partly saved as the case may be, but without particular attention being directed to the value of the dissolved constituents. Not so in dealing with soluble ores. In the case of sylvinite ores, for example, a saturated solution at operating temperature may contain 10% KCl in solution. If 5 units of weight of circuit water are employed for each unit of ore, the solution used with every ton of ore contains about 1000 pounds of dissolved potassium chloride. Good ore would contain 400 pounds of potassium chloride per ton. The amount of dissolved potassium chloride is 2½ times the amount of undissolved potassium chloride. One of the major objectives of a practical operation must be the saving of circuit brine for re-use. Separation of the brine from the concentrate is required so as to not contaminate an otherwise good product by dried-up, undesired salts from the medium.

An ordinary filter cake may contain on the order of 20% brine by weight in the interstitial pores. If this brine contains 10% potassium chloride, the loss of dissolved potassium chloride in an unwashed tailing would be equivalent to 2% solid KCl in the tailing. Since it is possible to reduce the undissolved KCl content to a fraction of one per cent, the assumed dissolved loss becomes the major item. If a potash ore contains 16% KCl and if the mechanical separation of KCl from other ore constituents is perfect, the KCl loss in solution in an unwashed tailing would amount to approximately 10% of the potassium content of the ore.

Since brine is lost to the wet concentrate and to the wet tailing it is necessary to add water to the system, hereby dissolving more ore. If this addition of water is made without care,

ore that is dissolved by the water addition will appear, indiscriminately, in the concentrate and the tailing. On the contrary, if addition of the necessary make-up water is made intelligently, instead of at random, the loss of valuable material in the tailing may be decreased or the purity of the concentrate increased or both. Price to be paid for this gain is that the plant immediately becomes a leaching plant as well as a flotation plant, with metallurgical care required in both.

Since most slimes are objectionable both for their reagent-consuming properties and because they contaminate the product, and since fine particles are difficult to separate by flotation as compared to moderately coarse sizes—it may be useful to first deslime the ore. Questions that may thus be raised regarding the slimes include inquiry as to whether they should be treated by some leaching step or discarded and also how the slime disposal will affect the solution balance of the system.

The brine lost from a saline flotation-leaching plant (medium lost to the system with concentrate and tailing cakes) and the replacement of the lost water from the general water supply suggest that temperature effects may occur. Because of the energy consumed in ore treatment and of inflowing heat from the outside, it is likely that the system will acquire a steady-state temperature higher than the water supply, with the result that water addition for brine-making or for leaching may exert a thermal influence.

Leach While Floating

Temperature fluctuations, also, must be expected as a consequence of changes in the weather, and this effect is markedly emphasized by the endothermic or exothermic characteristics of the dissolution in the make-up water of the soluble minerals. In the case of potassium chloride there is a very large endothermic effect and in the case of sodium chloride a moderately large effect. Other salts may cause thermal changes in the opposite direction. Finally, some salts may crystallize differently according to temperature (sodium sulphate for example) and large heat changes may be involved in the transformations.

There are therefore fluctuations in flotation-circuit temperature from place to place in the circuit, even in the absence of day-to-day fluctuations; but the two are generally present together. Since the solubility of various minerals that are to be separated varies with temperature, it is obvious that it should be advantageous to operate in an isothermal system. This was recognized by Weinig and made the object of some of the claims in a patent (17) concerned with the separation of potassium chloride from sodium chloride. Further, by creating systematic temperature fluctuations between parts of the plant system, it was shown by Weinig (17, 18) that selective dissolution of potassium chloride in one part of the flotation circuit can be compensated by selective crystallization of the same salt in another part of the circuit. Thus, the benefits of flotation can be supplemented by the advantages of the standard thermal or leaching-and-crystallization process.

It is pertinent to observe that the first Weinig scheme (isothermal system) is bound to require substantial capital expenditures, as well as fuel cost. The second Weinig scheme (systematic fluctuations) not only requires substantial capital expenditures and fuel costs, but it also establishes constraints as to the relative temperature of make-up water; the quantity that may be added and the place of addition, so that less operative freedom remains at the disposal of the metallurgist. On the other hand a higher recovery of potassium chloride is possible, and perhaps a purer product. Whether to use the process or not is therefore dictated by the economics in each specific instance.

Frothers May Be Needed

The outline that has been presented here indicates that soluble minerals are floatable, that this operation must be conducted in a saturated solution, and that practical application of leaching aspects of the process cannot be overlooked: whether these leaching aspects deal with dilution problems, water addition, or temperature control. Reagents used include soaps, alykyl sulphates and long-chained amines for mineral collection and a variety of protective colloids for slime control; frothers are sometimes used. Insoluble oils also may be advantageous if the separating step after reagentizing is conducted by table agglomeration.

Passing now from the historical and the engineering aspects to the scientific aspects of the problem it is possible that substantial differences in the detailed chemistry of flotation as applied to soluble and insoluble ores will eventually be made clear. This supposition rests on the fact that the concentration of ions in circuit liquors is greater in dealing with soluble ores than in the treating insoluble ores by a factor of from 10,000 to 1,000,000. As a consequence, the thickness of the ionic double layer around the particles, is several hundred times smaller in the case of salines. Just what effect this has on the ionization of collectors and on the physical-chemical properties of adsorbed films in their equilibria with the liquor is at present not clear.

Experimental difficulties in studying these phenomena appear immense, especially because of the very high concentration of non-participating ions; but the future may show a way to overcome the difficulties. It is certainly interesting to note that potassium and sodium chlorides are best separated by means of a cationic collector in which the head end of the cation (which is similar to ammonia) probably is of a size very near that of the potassium ion and much larger than the sodium ion. It has been shown by the Fuerstenaus (19) that it is possible to conclude that the reason why an aminium group will float sylvite and not float halite is because it fits in the place of a potassium ion but cannot fit in the place of a sodium ion.

Why alkyl sulphates should favor the flotation of potassium chloride over sodium chloride is unclear; perhaps this is related to the lesser solubility of potassium sulphate as compared to sodium sulphate. And finally why sodium chloride can be floated from potassium chloride through soaps in the presence of lead as an activator is even less subject to rationalization. There is much room left for scientific inquiry and engineering application.

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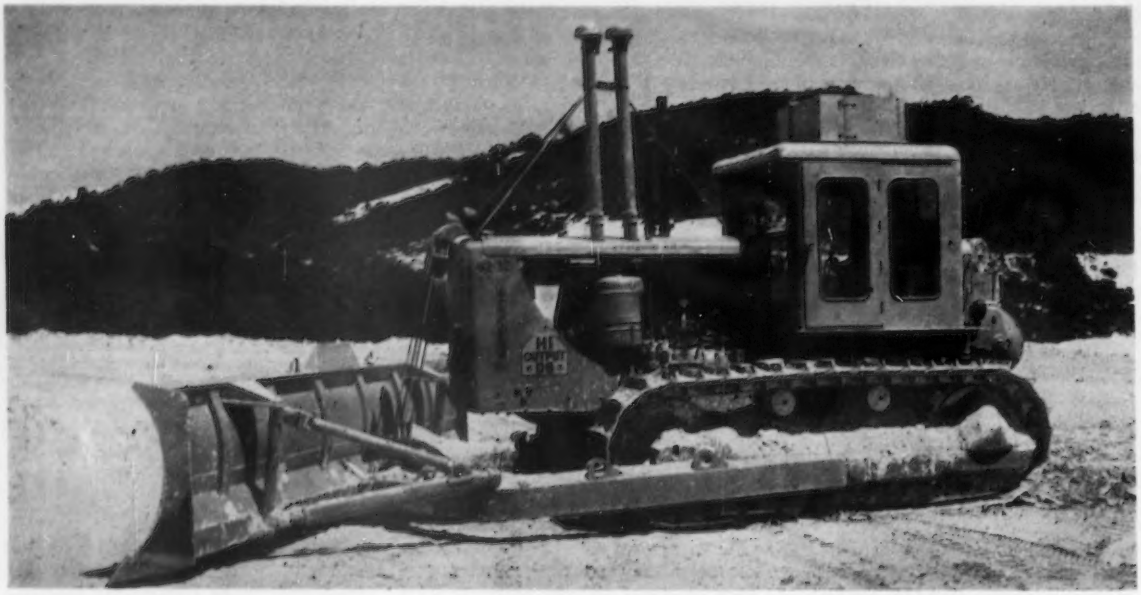


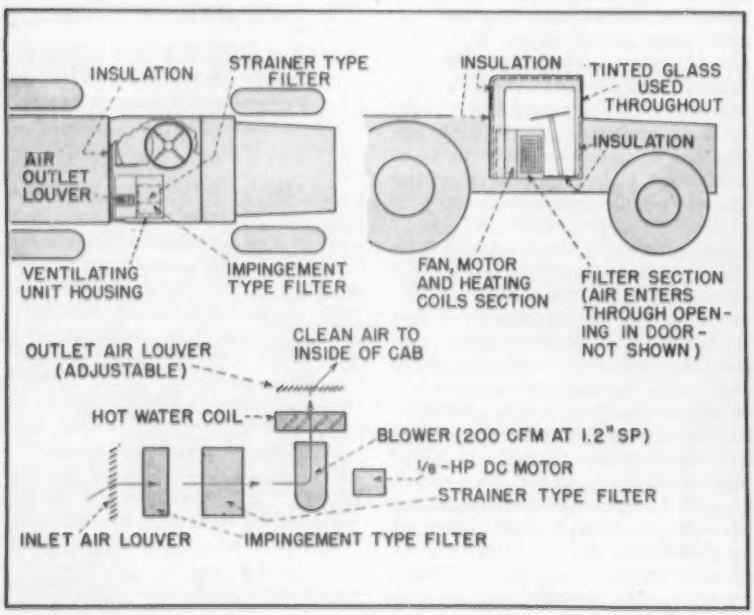
EVEN BULLDOZERS have totally enclosed cabs provided with dust-free circulating air, which also solves the cooling problem.

Ventilating Units Provide More Safety,

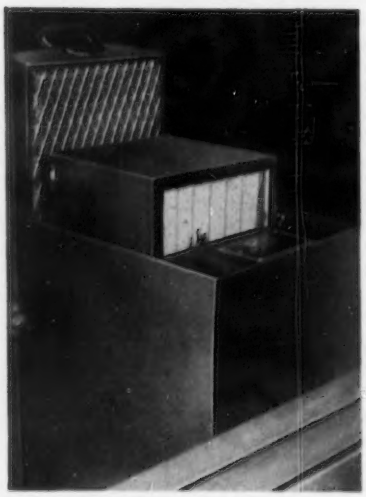
G. G. SCHUKNECHT
Assistant Manager
Johns-Manville, Lompoc, California

DEVELOPMENT of specially designed ventilating units for use on heavy duty open-pit mining equipment at the Johns-Manville diatomite mine at Lompoc, Calif., has added materially to the health, safety and comfort of the operators of the equipment. As can be seen from the accompanying table, dust counts have been lowered from as high as 110 mppcf (million particles per cubic foot) to a median of less than 5 mppcf.

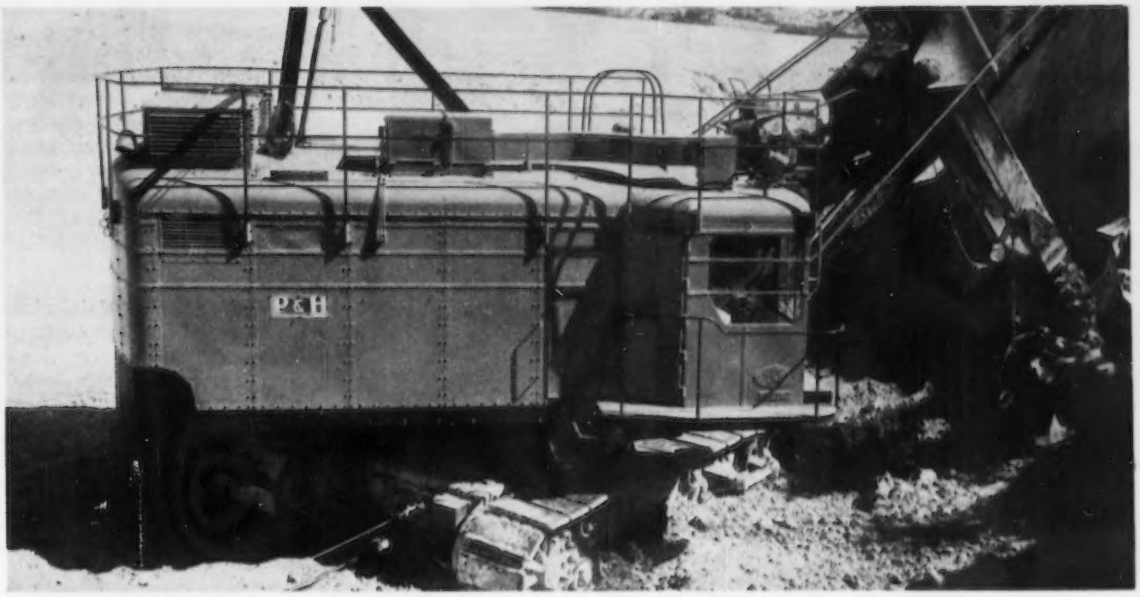
Best of all results in Johns-Manville's opinion, however, is the enthusiastic reception by the operators of the ventilating units. Without exception, the operators have expressed their appreciation of the clean air in their cabs and the added comfort and safety the ventilation has achieved. Driver visibility has been improved, eye injuries from dust practically eliminated and



This installation of



PRIMARY and secondary filters both fit easily in the cab of the truck.



ELECTRIC SHOVEL cab receives several changes of air per minute through duct work from unit placed atop the roof.

Comfort for Equipment Operators

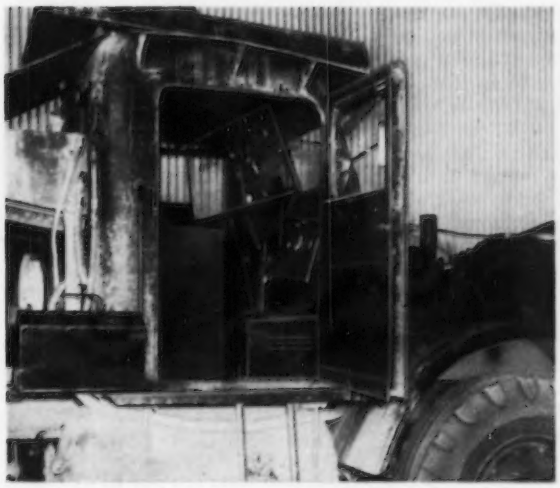
safety hazards due to reduced and impaired vision have been substantially minimized.

In addition to solving its own problem, Johns-Manville believes the ventilating units may be adaptable to other industries using similar heavy duty equipment in operations where dust control is a problem.

The Lompoc diatomite deposit, the world's largest, extends over an area of 4 square miles and is workable to a depth of about 700 ft. Diatomite is the fossilized remains of a tiny marine plant, the diatom, which lived and died some 15-million years ago. It is a soft, friable material, microscopically fine. 2,000 diatom skeletons lined up side by side would stretch a distance of not more than an inch.

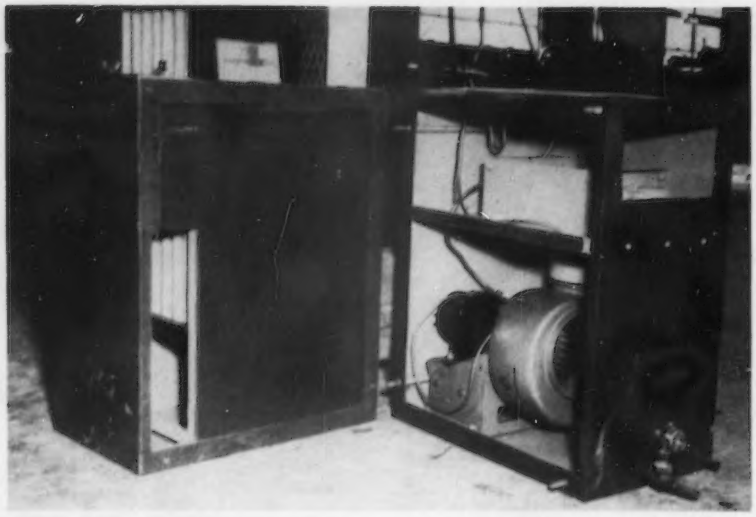
At Lompoc, overburden has been stripped from hundreds of acres of deposit, leaving the diatomite exposed to drying action by sun and wind. The mine is operated as a series of separate but well-integrated working quarries. 21 pieces of heavy equipment, in-

ventilating equipment is typical for the mine's 10 trucks.



DUST COUNTS in trucks like this have been reduced from as high as 54-million ppcf to as low as 2.0.

EASY ACCESS helps keep maintenance of ventilating units down to 1.2 man-hours per month for each.



VENTILATING UNIT is ready for installation in the cab of a bottom dump truck.

cluding bulldozers, road graders, power shovels, loaders and trucks, remove the overburden and haul the crude diatomite directly to storage "glory holes" which are vertical shafts located directly over an underground haulage system.

When needed, crude diatomite is drawn from the bottom of the glory holes and dropped directly into cars of an underground electric mine train for hauling to the mill.

In addition to the drying action of the sun, aggravated by the presence of any breeze, dust is created by the actual stripping and quarrying operation, as is typical of most similar mining activities. An upsurge of activity at Lompoc some years ago created operating conditions in the quarry which dictated the necessity of having some type of ventilating unit on each major piece of equipment.

While it has been possible to keep the roadways and active mining areas within the deposit watered down, it is not practical to do this over the vast area which is not used by quarry traffic.

Early Obstacles

Actual engineering work on the ventilating unit project began in 1949 and was successfully completed in 1955. In reaching Johns-Manville's objective of providing clean air for equipment operators to breathe, many obstacles were overcome.

Most serious of these was the absence of any existing unit to do the job. Johns-Manville engineers conducted experiments with a heavy duty ventilating unit offered by an equipment manufacturer which proved unsatisfactory, and 25 additional manufacturers and several private engineering firms were approached in an attempt to find a workable method of ventilating the equipment cabs properly.

In gathering data for determining the extent of the ventilation needed, the first step of Johns-Manville's engineers was to take extensive dust counts under every conceivable type of operating condition. The U. S. Public Health Service and the California Department of Public Health worked with company engineers in taking dust samples which augmented the company's own air sampling results.

These dust counts ranged from 3.3 to 110.3 mppcf of 0.5 to 10 microns in size with median value of 16.7 mppcf. 95% of all dust counts were over 5 mppcf.

The company's objective was to lower median dust concentrations in the equipment cabs to less than 5 mppcf, maintain comfortable temperatures inside the cabs in both hot and cold weather, improve visibility and general working conditions for the equipment operators and reduce safety hazards.

At first, Johns-Manville engineers believed refrigeration would have to be included to keep the tightly closed cabs cool enough for operator comfort. This idea was abandoned soon after it was found that sufficient air movement in the cabs, combined with thermal resistant safety glass, provided operator comfort on even the warmest days. In addition, tops, sides, bottoms and fire walls of the cabs were insulated with a 1-in. thickness of a Johns-Manville thermal insulation.

The engineering staff also had to come up with a design for a ventilating unit which would be compact enough to fit into the very limited cab area on most of the equipment and at the same time withstand the severe service to which earth moving equipment is generally subjected. Much attention was also given to designing a unit which would require a minimum of maintenance and would be readily accessible for that purpose.

After 4 years of trial and error experiment, the first satisfactory unit was installed and tested in 1953. The actual engineering work was performed by the Lompoc mine engineering staff and Johns-Manville's General Plant Engineering Department.

Ventilation Unit Components

The final units, which more than fulfilled the requirements established, were developed and installed by Kilpatrick & Co., contracting engineers of Alhambra, Calif. Installation of the last of the 21 units was completed in 1955.

Components of the ventilating units finally installed are as follows:

Blowers, used on the trucks and bulldozers, are Buffalo Size C Baby Ventilation type which supply 200 cfm. Similar blowers, supplying up to 2,000 cfm, are used on the large shovels. The blowers are driven by Pierson-Frame No. 13, ⅛-hp 1,750-rpm, 6-dc motors.

Generators, Delco-Remy heavy duty 50 amp, 6v, dc, set with 200-amp hr batteries were installed on each piece of equipment as auxiliary power units to supply independent power to drive the ventilation fans.

Air filtering is accomplished in two-stages. Primary filtering is through an American Air Filter Co. 12x24-in. surface wire type filter, Model MW-4 impregnated with BA Viscosine oil. The secondary air filtering stage is through an American Air Filter Co. 12x24-in. surface paper filter No. PL-24 using 10 ply Type S Airmat paper. The in-cab fresh air outlet has a louvered directional control which has been found important to operator comfort.

Filtered air is supplied to the cabs with a slight positive pressure inside the cab (about 1/16-in. water gage) so that outside dust or air does not get into the cab through any unsealed openings, although as much sealing as practical has been done.

Each ventilating unit provides from 1 to 5 complete air changes per minute in each cab, the variation depending upon the size of the cab and the normal conditions under which the individual piece of equipment is operated.

Ventilation Unit Maintenance

To maintain the ventilating equipment with a minimum amount of downtime, a small service shop was

built adjacent to the mining areas where spare filters for each unit and other supplies are kept. Each ventilating unit is serviced in the field on the basis of 8 hr of operation.

A specially designed trailer is attached to the filter service pick-up truck. It is equipped with dust tight compartments for transporting spare filters and supplies. It also has a powerful vacuum cleaner so the service man can vacuum out the inside of cabs at the same time the filter is changed.

Filter units changed in the field are brought back to the service shop where they are steam cleaned and oil dipped and filter cloths changed, ready for reuse. Field servicing of the prime loaders is done during the lunch hour so no mining equipment production time is lost.

It is important to thoroughly clean the equipment cabs daily during the field service, particularly the floor area. Operators occasionally need to get in and out of the cabs during the normal day and even reasonable diligence on the part of the operator in cleaning his shoes does not prevent a certain amount of dust being brought into the cab or coming in through the opened door.

Maintenance and upkeep of the ventilating units has averaged 1.2 man-hours per month for each piece of equipment with a total cost per month for labor and supplies of $27.80 per piece of mining equipment.

Approximately 80 man-hours were required to completely modify equipment cabs and install ventilation units. The 21 units cost a total of $51,682 or an average of $2,461 each, including all experimental and development work.

Results Beyond Expectations

Results have exceeded expectations. Air within the cabs of all mining equipment was sampled in two stages following installation of the ventilating units. The first stage of the survey was made immediately after all units had been installed, but before sufficient operating and maintenance experience had been gained to eliminate all trouble points. The second stage was conducted after minor changes had been made in some of the filtering units and the maintenance program was firmly established.

39 counts were made in the first stage—ranging from 1.0 to 12.7 mppcf with a median value of 3.7 mppcf and the dust particle size range of 0.5 to 10 microns. Only 23% of the counts were over 5 mppcf.

40 counts were made in the second stage—ranging from 1.0 to 11.3 mppcf with a median value of 3.5 mppcf and the same particle size range that was observed during the first stage. The counts over 5 mppcf, however, amounted to only 12.5% during the second stage of the survey.

Johns-Manville engineers are quick to point out that such satisfactory results were achieved through the active help and cooperation of the equipment operators. The operators were not only consulted frequently throughout the design period of the project by the engineers, but contributed many suggestions, themselves, which were incorporated in the design of the ventilating units. These operator suggestions have helped achieve more efficient operation and reduced maintenance cost.

Mining equipment on which the ventilating units have been installed at Lompoc include ten bottom dump trucks; five bulldozers; two road graders; one electric shovel; one diesel shovel; one tow tractor; and one truck crane.

How Ventilation Reduced Dust Counts In Quarry Vehicle Cabs

(In million particles per cubic foot)

Equipment	Before Ventilation (a)	After Ventilation (b) 1st Stage	After Ventilation (b) 2nd Stage
BOTTOM DUMP TRUCKS			
No. 131	—	2.6	3.2—3.3
No. 132	19.5—20.3	1.0	3.9—4.0
No. 133	33.0—92.5	3.3	2.1—4.2
No. 134	4.5—8.4	3.3—3.7	4.0
No. 135	8.2—11.5	1.9	1.8—2.3
No. 136	6.0—67.9	1.2	1.7—3.0
No. 137	10.7—45.7	2.4—5.0	3.4
No. 138	**18.0**—37.9	2.0—8.4(c)	3.5—5.6
No. 139	—	3.0—4.4	3.0
No. 140	**8.0—12.0—13.8 13.8—19.0—20.0** 26.3—54.4	2.4	2.0—4.1
BULLDOZERS			
No. F-4	16.7	Removed from service	
No. F-20	5.9—7.3—8.3 8.6—17.6—**22.0 46.3**	Removed from service	
No. 21	7.5	5.4(d)—12.7(e)	2.8—3.5—4.0 5.3(g)—11.3(g)
No. 24	—	2.9—3.3—3.8 5.4(e)—7.8	4.3
No. F-25	110.3	Removed from service	
No. 26	6.6—31.0	1.5—3.0 3.3—6.1(e)	3.4
No. F-28	10.3—37.8	Removed from service	
No. 31	—	4.2—4.3—4.8 10.0(e)—8.6(f)	4.9
MOTOR GRADERS			
No. 23	7.7—11.6	2.1	1.0—2.0—7.4(g)
No. 28	10.9—14.2	Removed from service	
No. 30	—	1.8	3.7—3.8
MISCELLANEOUS			
Electric Shovel	3.3—36.2—52.1	—	1.9—2.2—4.5(g)
Diesel Shovel	16.8—29.6	—	1.2—2.2—4.6
Truck Crane	10.0	2.8—4.9(f) 5.8(f)	—
Truck Loader	12.5—22.4—38.3	2.2	2.0—3.2

(a) Counts in boldface taken by Johns-Manville; remainder by U. S. Public Health Service and California Department of Health.

(b) All counts after installation of ventilating units by Johns-Manville.

(c) Filter unit out of order.

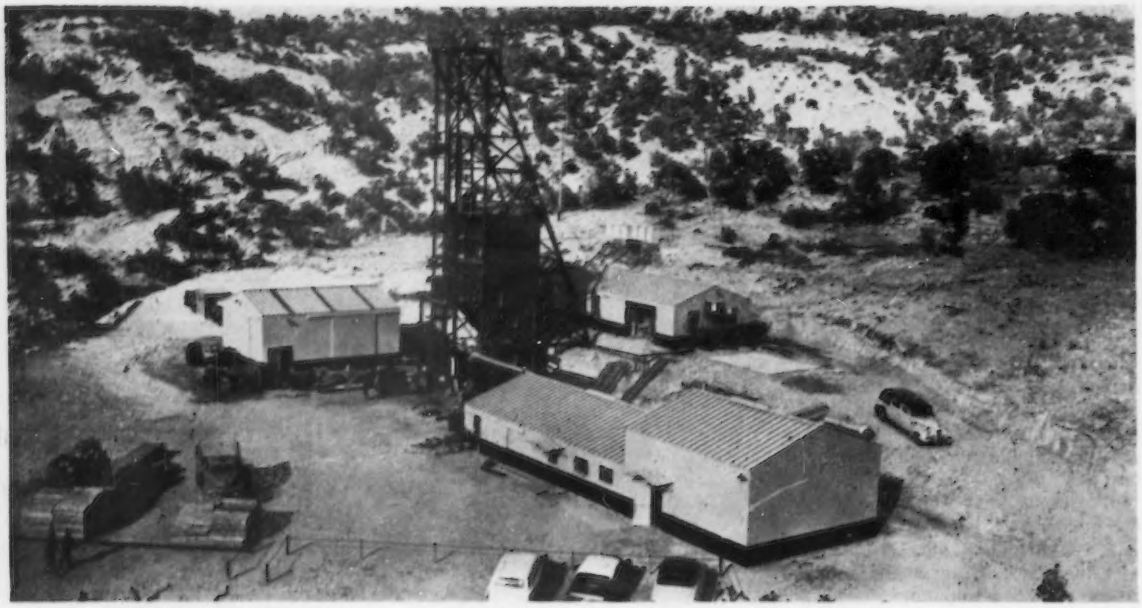
(d) Sprung door on filter chamber—leaking air.

(e) Loose filter—leaking air.

(f) Filter used over 8 hours.

(g) More than usual amount of dirt in vehicle cab from operator's feet.

Before the second dust survey was made, items (c) and (f) were corrected.



MODERN EQUIPMENT is housed in new all-steel buildings. See plan at right which identifies the various buildings shown above.

How the Radon Was Developed Into a Model Small Mine

W. H. LOVE
Superintendent Radon Operations
Hecla Mining Co.
Moab, Utah

The Big Indian uranium boom near Moab, Utah, gave rise to a number of small producing properties and some fairly large ones. One of these is the Radon mine. When E&MJ *visited the property last Fall, W. H. Love and his staff were busy installing the skips and cages in the newly completed shaft. How Radon grew from a prospect to a mine is told in the following paragraphs, with facts supplied by Mr. Love.*—Editor.

Claims Staked in 1953

RADON CLAIMS were staked in early 1953 following Charley Steen's famous discovery in Big Indian Wash, San Juan County, Utah. The property is situated about five miles north of the Mi Vida mine. Four holes were drilled on one of the claims with negative results. Then the U&I Uranium Co. of Kellogg, Idaho, obtained control of the ground. Subsequent drilling proved existence of substantial ore reserves, and an agreement was made by U&I and the Hecla Mining Co., under

W. H. Love, superintendent

which Hecla was to develop and mine the property under a profit-sharing agreement. Hecla started work on the property in 1954. Until March 1955 this consisted entirely of drilling. In the spring of 1955, U&I concluded a merger agreement with Federal Uranium Corp., and Hecla's operating contract was transferred to Federal.

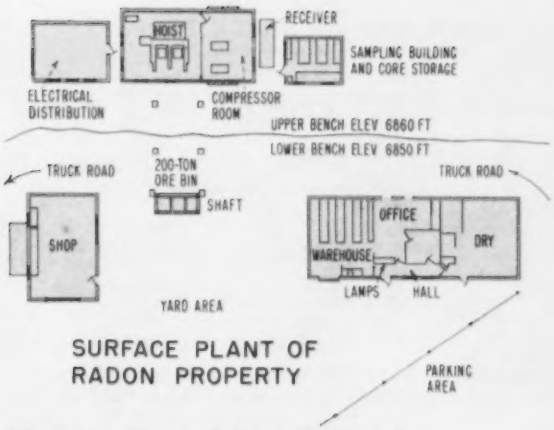
What Drilling Revealed

Study of the claim map will show how exploration drilling revealed a flat-lying orebody dipping about 7 deg to the west (conforming to the west flank of the Lisbon anticline). The ore lies in the lowest member of the Chinle formation at its contact with the underlying Cutler sandstone.

The Chinle in the area is 400 to 420 ft thick, overlain by Wingate sandstone, much of which has been eroded. Strike of the ore trend is about N 22 deg W, and strike length of the Radon property is about 2200 ft. Width of the orebody varies from 400 to 600 ft, and thickness up to 8 ft. Ore is principally uraninite in an arkosic sandstone. Mudstone layers above and below the hard sand bed also contain appreciable values.

How the Mine Was Planned

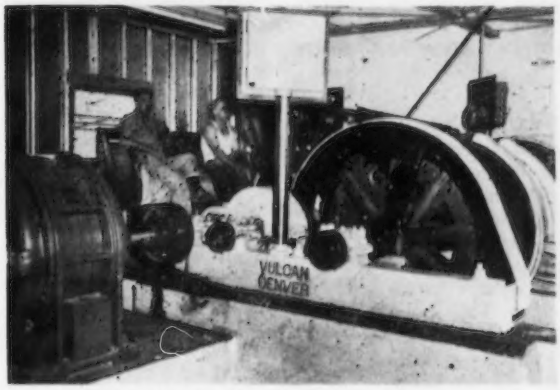
Hecla's first step was to add drilling data to that already obtained by U&I to determine a feasible shaft site, ascertain more precise limits of the orebody and determine grade and reserve tonnage. The shaft site was selected so that the shaft would intersect the down-dip edge of the deposit, about on its center strikewise. This limited maximum haulage distance to about 1100 ft in each strike direction. Optimum production was set at 250 tpd, but provisions were made in plant de-



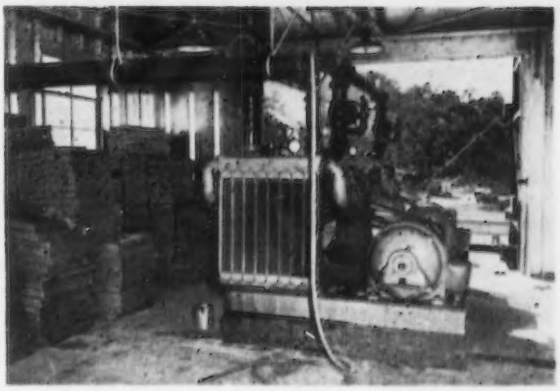
SURFACE PLANT OF RADON PROPERTY

Plant Is Geared for 250 tpd.

MAIN SURFACE UNITS include the steel headframe with ore bin shown at right and the compressor plant and hoist room (below) which permit hoistman to operate both hoist and compressors. Hoist is equipped with 100-hp motor.



DOUBLE-DRUM HOIST is powered to hoist ore 600-ft.



WATER SCARCITY dictated use of air-cooled compressors.

sign to go to 400 tpd if it should become necessary to increase the mining rate before 1962.

Model Surface Plant

Accompanying photographs and a plan show the new surface plant. All buildings are steel, built by the Armco Steel Co. The shop was spotted to be convenient to the shaft collar. A monorail was installed to convey machinery from the shaft collar to the shop. Hoisthouse and compressor building are combined so that the hoistman can take care of the compressors as well as the hoist. A diesel power plant was installed for early operations, but now a power line feeds the property.

Hoisting Plant. Calculation of several duty cycles favored installation of a double-drum machine with a 75- to 100-hp motor operating for a hoisting speed of about 400 fpm. Single-drum hoisting was considered but this proved to be uneconomical for a 600-ft hoisting depth. The current Vulcan 100-hp double drum hoist is equipped with Lilly Simplex controllers and a mechanical clutch-brake safety interlock.

Two choices were considered to handle ore at the collar: (1) Dumping the ore on the ground and rehandling it with a front-end loader, and (2) installing a steel bin in the headframe. The latter proved to be more economical when it was learned that a steel bin would cost no more than a loader. Trucks are now loaded directly from the bin.

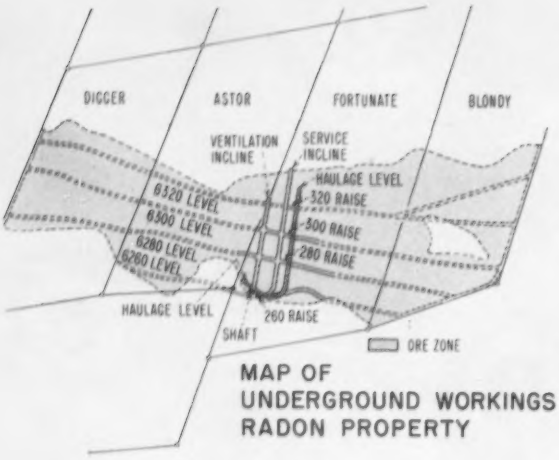
Compressed Air. Lack of water at the property resulted in selection of simplicity air-cooled machines. Two I.R. Model 90B compressors, each with 515-cfm displacement, are now installed and provision has been made for a third if required.

Power. Three Caterpillar Diesel D-13000, 100-kw units were installed to generate power for the property. These units operated in parallel. However the mine switched over to Utah Power & Light Co.'s lines when they came into the district in October 1955. One 300-kva, 12470/440v transformer feeds the surface plant; and one 150-kva, 12470/2300v unit supplies underground workings. Power is taken down the shaft to two 75-kva, 2300/440v substations through a lead-covered 2300v feeder cable.

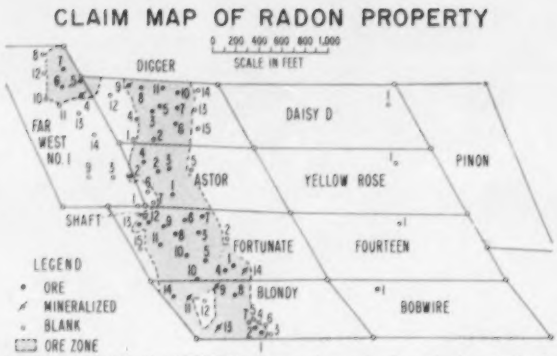
The Shop. Equipment includes a forge, power saw, drill press, Porto-power unit, welder, oxy-acetylene set, grinder, bit grinder. No lathe work is done, but all other mechanical work and vehicle maintenance is handled in the shop. A preventive maintenance system has been set up for the plant and underground operations.

How the Mine Was Developed

The Shaft. Radon's shaft contains three 4x4x5-ft compartments, two for hoisting, and one for a manway and service. Total depth of the shaft is



MAP OF UNDERGROUND WORKINGS RADON PROPERTY



DRILL-HOLE PATTERN shows how limits of the orebody were determined. Orebody dips about 7 deg to the West (left).

MINE IS DEVELOPED through four drifts parallel to the strike. Drifts are driven on approximately 120-ft centers.

690 ft. The first 21 ft was sunk with crane and clamshell. The remaining 669 ft was sunk in 65½ days. Average advance was 10.2 ft per day, or 0.87 ft per man shift. Sinking bucket capacity was 30 cu ft. Present permanent skips are 50-cu ft Kimberly units. Each skip is suspended under a man cage.

Mine Development. Note in the accompanying plan that four drifts have been driven along the strike of the orebody on about 120-ft centers. A haulage crosscut was driven from the shaft to intersect these drifts at right angles. Raises driven from this crosscut intersect each of the four drifts. The haulage level is 40 ft below the ore at the shaft, and because of the dip of the orebody, this interval increases to 100 ft at the raise farthest from the shaft. The elevation of each of the four drifts is shown on the mine map. These drifts are connected by a service incline driven from the main shaft station cut on the 6260 level. A fugger hoist moves equipment to the levels.

Shaft Pocket. Because the ore is sometimes sticky and hard to handle, a slusher-type shaft pocket was installed instead of the usual skip pocket. This minimized hang-ups due to sticking. Muck is slushed into two steel loading cartridges, each designed to hold exactly one skipload. Loading gates are air-operated. Slushing is done during hoisting. A remote control system enables the cager to operate the slusher while standing at the loading point. The slushing pocket is 100 ft long, 50 ft on each side of the shaft. Thus, if necessary, one side can be used for waste, and one for ore.

Haulage. The haulage crosscut is 500 ft long. Trains in this crosscut consist of five 40-cu ft rocker-dump cars and a 1½-ton GE trammer on 24-in. track gage. Three raises were driven from the crosscut to drifts above for ore transfer. The fourth raise, to the 6260 level, was driven from the slusher pocket to eliminate ore transfer.

Raises. The possibility of hang-ups made it necessary to install cribbing in the raises for a manway adjacent to a joker chute. The cribbed section is 5x6 ft outside, and the joker chute, 6x7 ft. Cribbing consists of 6x8-in. timber on edge on the chute side. This was framed so that 3-in. spaces remain between successive rings. This space fills up rapidly with fine muck which can be poked through readily if it becomes necessary to bar down a hang-up. Because of the heavy tonnage to be pulled through the raises, steel chute lips with air-operated upcut gates were installed.

Ventilation. A small ventilation incline was driven on ore from the manway to the shaft to intersect the four drifts. A 20,000-cfm Axivane fan exhausts air from this incline through 630 ft of 30-in. galvanized iron tubing installed in the manway of the shaft. A ventilation crossover will be used at each drift to exhaust foul air from each heading. Headings will be exhausted by a 20-hp Axivane fan pulling through fan tubing and blowing directly into the sealed crossover. When necessary, scavenger fans blowing through 12-in. fan bag will be used to sweep the face. Stopes will be ventilated by means of doors and brattices controlling air flow.

Drilling and Breaking. Two jumbos each fitted with two Cleveland 6-ft booms are mounted on Hecla-made trucks with 10-ton hydraulic hold-downs. Automatic feed DB-50 drifters are used on the jumbos with ⅞-in. hex steel and 1½-in. carbide bits.

The ground is soft, muddy and springy. Thus burns tend to freeze badly. Downcuts and pyramid cuts, efficiently drilled by the jumbo with short (30-in.) change machine, have proved best. Drilling rate is about 24 to 30 in. per min. Holes tend to mud up behind the bit, necessitating frequent blowing and cleaning.

A Holman Dryductor drill has been used successfully on an experimental basis. Its greatest advantage is the beautiful clean hole it drills. Holes need not be blown before loading, and the steel can be pulled easily.

High strength, low velocity powder appears to be best for Radon ground. Best results have been obtained to date with DuPont Extra A-1 55% strength by volume, with a velocity of 8200 fps.

The overlying Chinle beds consist almost entirely of mudstone and siltstone, completely incompetent and subject to marked deterioration from the action of air and moisture. Headings driven and allowed to stand for as much as a week without support slack and slough badly.

Although there appears to be little weight or pressure, as such, on openings, the ground slacks and sloughs in a treacherous manner, giving no warning. There is no known stopping point for this sloughing; rather it will go on without letup until it is properly caught. Arching of the back is not too helpful, as the corners tend to fall out. Therefore the back is generally carried flat, then supported.

Both timber and rock bolts have been used, the latter with chain link fabric. This has proven quite successful, but depends upon a close pattern of bolt spacing to give the screen the necessary support. Headboards on the bolts have been helpful, and should not rot out before they serve their purpose.

These Tests Offer a Reagent Combination . . .

Test No.	Product Name	Weight %	Assay, % Mn	Fe	Insol.	P	% distribution of Mn	pH	Reagents lb per ton — Depressants NaH_2PO_4	Na_2SiO_3	Collector Na-oleate	Frother Hexanol	Flotation time, min
1	F-3 ore	100.0	25.9	4.02	47.12		100.0						
	Rough conc	67.4	36.6	2.98	32.6		94.8	8.0	1.5	3.0	3.6	0.09	5
	Clean conc	**48.7**	**48.0**	**2.23**	**15.2**	**0.128**	**89.6**	**8.3**	**0.5**	**2.0**		**0.09**	**4**
	Rough tail	32.6	4.1	6.2	77.1		5.2						
	Clean tail	18.7	7.3	4.9	77.9	0.271	5.2						
2	J-3 ore	100.0	30.5	8.6	32.0		100.0						
	Rough conc	91.7	32.1	8.6	29.8		96.3	8.0	1.5	0.5	4.4	0.09	5
	1-Clean conc	81.1	34.6	8.8	25.9		92.0	8.6		1.0			5
	2-Clean conc	73.6	37.0	8.7	22.6		89.1	8.5	2.0	1.0			5
	3-Clean conc	**60.3**	**41.3**	**8.6**	**15.8**	**0.257**	**81.6**	**8.9**					**6**
	Rough tail	8.3	13.9	7.6	56.4		3.7						
	1-Clean tail	10.6	12.6	7.6	58.6		4.3						
	2-Clean tail	7.5	11.9	9.4	59.1		2.9						
	3-Clean tail	13.3	17.3	9.3	53.2	0.357	7.5						
3	I-3 ore	100.0	16.5	9.9	47.2		100.0						
	Rough conc	76.2	20.3	10.0	40.0		93.5	8.0	2.0	2.0	3.8	0.18	5
	1-Clean conc	60.0	24.2	10.0	32.8		88.0	8.5	1.0	1.0			5
	2-Clean conc	43.6	30.6	10.0	20.8		80.9	8.3	3.0	2.0		0.09	5
	3-Clean conc	**30.3**	**37.9**	**8.7**	**9.1**	**0.275**	**69.7**	**9.0**					**3**
	Rough tail	23.8	4.5	9.3	70.0		6.5						
	1-Clean tail	16.2	5.6	9.8	66.9		5.5						
	2-Clean tail	16.4	7.1	10.1	64.9		7.1						
	3-Clean tail	13.3	13.9	13.1	47.3	0.368	11.2						
4	A-3 table product	100.0	9.3	27.7	26.7		100.0						
	Rough conc	80.6	10.4	28.0	23.3		90.5	8.0	4.0	4.0	2.8	0.09	3.5
	1-Clean	71.6	11.3	28.8	20.0		86.9	8.3	3.0	1.0			4
	2-Clean	56.6	13.2	29.4	14.6		79.6	9.0	1.0	1.5		0.09	4
	3-Clean	**37.2**	**17.5**	**28.4**	**10.2**	**0.881**	**70.0**	**9.0**	**2.0**				**3.5**

. . . To Float Low-Grade Manganese Ore

SHIOU CHAUN SUN
P. E. MORRIS

UNDER CERTAIN RESTRICTIVE CONDITIONS low-grade manganese ore can be beneficiated by flotation, at reasonable recoveries, as a result of laboratory work on the reagent combinations described herein. These tests were conducted at Pennsylvania State University on low-grade manganese ore from the Sherman Valley area, Pennsylvania[1, 2, 3]. Heretofore, sporadic selective mining and log washing had been able to produce only meager amounts of saleable concentrates, at low recoveries from these deposits. Proper choice of reagents and pH made it possible to produce concentrates that more than satisfied minimum U. S. stockpile requirements for domestic manganese. [Although these tests were applied to solving the problems of Pennsylvania low-grade manganese, these data ought to be tested on other manganese ores and as a possible means of upgrading the low-grade material in our domestic stockpile.—Ed.]

S. C. Sun is Associate Professor, Mineral Preparations, Pennsylvania State University and P. E. Morris was Metallurgist for Manganese, Inc., Henderson, Nev., is presently with the U. S. Army.

Channel samples received from several ore deposits were crushed to minus 1 in. and then log washed to remove the minus 65 mesh clayey materials which contained about 0.5% Mn. Washed ore was ground to minus 150 mesh for flotation in a laboratory Fagergren machine, using 500 gm samples for each test. Sodium hydroxide and hydrochloric acid were used as pH regulators and tap water was used for all flotation tests.

In a series of tests, the favorable flotation reagents were found to include sodium dihydro orthophosphate and sodium silicate as depressants, sodium oleate as collector and hexyl alcohol as frother. In the presence of sodium silicate, sodium dihydro orthophosphate proved to be a better depressant and/or water conditioner for these particular ores than either sodium hexametaphosphate[4], phosphomolybdic acid, sodium hypophosphite, tannic acid[5] or Quebraco[6]. Sodium oleate proved to be a better collector than the amines and could be replaced by either oleic acid, Reagent 708, tall oil, or an emulsion[7] of soap, fuel oil and Oronite-S.

Optimum pH value for the rougher circuit was found to be 8.0, as shown in the table. Necessary pH for cleaning varied from 8.3 to 9.0; increasing directly with the iron content of the ore.

Further tests established the proper quantities of reagents. Work was also performed to preconcentrate the lowest grade ores by tabling prior to flotation. The results on tabled ore are included in the table. Referring to the tables, tests 1 to 3 indicate that ores containing more than 10% Mn and less than 16% Fe could be upgraded by flotation to meet the minimum specifications[8] of 40% Mn, 16% Fe, 15% SiO_2 and alumina, and 0.3% P. [Other requirements of the domestic manganese stockpile include: copper, 0.25% maximum and total Cu, Pb and Zn, 1.0% maximum. Penalties are

(*Continued on p 115*)

CAMP HAS BEEN COMPLETED, with shaft at far left, general engineering offices and mess hall in right background toward Kuskokwin

Red Devil—Alaska's Next Mercury

H. R. BECKWITH
DeCoursey Mountain Mining Co., Ltd.
Anchorage, Alaska

UNDER NEW MANAGEMENT, the more than twenty-year-old mercury property on Alaska's Kuskokwin River, about 250 miles west of Anchorage and about 7 miles below Sleetmute, will be the scene of considerable activity this summer. Having carefully examined the present favorable mercury situation, the very high cost of skilled labor, the extreme shipping costs, and the isolation of the area, DeCoursey-Brenwis Minerals, Ltd. will begin full scale mining activity when the first boatload of supplies arrives this June.

Discovered in 1920, this property, located on the bank of Red Devil Creek, a small tributary of the Kuskokwin, became known as the Red Devil mine and was worked intermittently until the war-stimulated demand for mercury encouraged DeCoursey Mountain Mining Co., Ltd. to install a 40-ton rotary furnace at the mine. Red Devil produced 3900 flasks between 1943 and 1954 when the property came under control of DeCoursey-Brenwis Minerals Co., Ltd., a Canadian firm and present operator.

Last year the new owners undertook an extensive examination of the property, which included surface investigations, underground development, mill, mine and camp layout and construction, and finally a cost evaluation of the program.

Present course of the Kuskokwin in the vicinity of Red Devil follows along the axis of the Sleetmute anticline and is traceable for several miles. Sedimentary rocks strike N 25 to 35 deg W and dip 30 to 60 deg NE along the northern bank and strike N 50 to 55 deg SW on southern bank of the river at the Red Devil. To the east a few miles beyond Sleetmute, a large regional fault, the Holitna-Farwell, strikes northeast. Country rock is a bed of Cretaceous sediments, several thousand feet thick. Rocks known as the Kuskokwin group consist of interbedded graywacky, sandstone and shale. Generally they are dark in color and have a coarse to fine-grained texture, being altered close to mineralized zones. Large concentration of carbonaceous or ferruginous material gives rise to very black, shiny seams in the shale.

Surface Was Examined

Shattering, shearing and opening up of deep-seated fissures seems to have taken place in Tertiary times. The largest exposure of igneous rock is Barometer Mountain, at the head of Red Devil Creek where it intrudes into the Cretaceous sediments. This is classified as a rhyolitic intrusion. Mineralization appears to be associated with or in close relationship to younger intrusive sheets which have followed along openings or bedding plains. They are narrow sills, mantos or lenticular-shaped plugs cutting, at times, the bedded country rocks or following fissuring or shearing.

Cinnabar is the prime economic mineral, although stibnite is more abundant. Cinnabar occurs either massive or disseminated as lenses, pods or thin streaks varying in width from mere cleavage coatings to nearly solid masses. It also appears as a solid streak several feet long banded by quartz-carbonates. Stibnite forms clusters, needles as rosettes in wall rock or massive lenses or pods, 1 to 15-in. wide, commonly carrying veinlets or solid streaks of cinnabar.

Stibnite cannot be exploited commercially, but as a secondary mineral it may have value. Pyrite, arsenopyrite and realgar are the other sulphides. White-sugar quartz is principal gangue mineral along with a carbonate mineral, mainly calcite. Replacement of wall rock and isolated fragments of the younger sills is common. Close interlocking of sulphides requires fine grinding.

Most of the cinnabar is free of stibnite. Some of it is trapped in the massive stibnite. Research on Red Devil ore shows the mercury mineral is pure cinnabar. So far no complex mercury minerals have been noted. In the case of interlocking stibnite, pyrite and arsenopyrite, it appears to be physical rather than chemical.

During 1955, a geochemical survey was undertaken. Twenty-five anomalies were outlined; five showing considerable promise, 15 requiring further study.

Original workings at Red Devil were small shallow holes along the exposed outcrops and the hand-sorting of the overburden for lump stibnite-cinnabar. The old adit, back of the present in-

River. Recovery-plant started up in February.

SUPPLIES WILL BE DELIVERED in good weather on river boats and the tanker.

Producer

cline shaft, was driven several years ago but the backs were limited. The incline shaft was sunk to the first (100 ft) level and stoping produced ore from high grade lenses in 1942-43. Later the shaft was sunk to the second level, where cross-cutting encountered the downward extensions of the orebody. Production of 980 flasks from 2,465 tons ore mainly came from this second level, before mining ended in 1954.

Early in 1955, under direction of DeCoursey-Brenwis, the inclined shaft was deepened to the third level, 150 ft below the second. Of several ore zones encounterd, C zone is the most promising and was once mined up on the second level. C zone ore was found to be strong and well-defined on the third level, indicating a sizeable orebody.

It is quite difficult to estimate ore reserves. Exploration results on the second and third levels, especially in the C zone, indicate that considerable tonnage can be proven by further work. Geochemical work on the surface points to other orebodies in the vicinity.

When the mine was last worked (1954), mercury recovery on second level ore in the C zone averaged 16.7 lb Hg per ton. During that year, 980 flasks were produced. Production records have not been carefully kept and the efficiency of the old retort is open to question. Since 1943 some 3,900 flasks have been produced from 7,631 tons ore. This is an over-all recovery of 34.8 lb of mercury per ton. Recovery in 1944 averaged 31.5 lb Hg per ton; in 1945, 48.3 lb Hg; and in 1954, 30 lb Hg. Yield was somewhat low due to high antimony content and the shape of the retort. With the new 50-ton furnace, better recoveries are anticipated.

The Costs Were Analyzed

Wages in the area come high. Skilled surface labor hourly wages start at $1.67 and go to as much as $2.75. Underground wages start at $2.75 per hour. Fortunately, plenty of local residents are available and can be trained to do the work. This will cut production costs considerably.

While labor costs present somewhat of a problem, the major cost obstacle is the very high freight costs. Everything comes to Bethel from Seattle by ship during June through late August. Bethel is about 90 miles from the ocean, and offers good protection from severe Bering Sea weather. Supplies come to the mine on river boats; either the company-owned Cinnabar or on commercial river boats. The Cinnabar is all steel, shallow draft, diesel-powered and can carry 5,000 gallons in four fuel oil bunkers. In addition the Cinnabar can take a sizeable deck load; cutting over-all shipping costs considerably.

Ocean freight from Seattle to Bethel costs about $85 per ton. Costs on the river to the mine start at $38 per ton. Once the mine is firmly established, freight costs can be cut by doing most of the shipping on the Cinnabar.

With the knowledge that a good orebody exists and that labor and freight costs can be held to a reasonable level, construction work on the camp was started in February 1955, extreme weather conditions notwithstanding. Since then an independent community equipped with a bunkhouse, six homes, mess hall, storehouses, offices and even a school has been set up.

A 10-ft, six-hearth Pacific Foundry retort furnace, complete with condensers, mechanical soot collectors and other auxiliaries, has been installed. Rated capacity of the retort is 50 tpd. All units, including a coarse-ore bin, Telesmith crusher and conveyor are housed in a steel-frame building. Ample space for calcine disposal is available.

The oil depot consists of five bolted steel tanks with total capacity of 9,000 gallons. They are located on the east side of Red Devil Creek, away from the camp and plant. Tanks are 100 ft apart, ditched, banked for fire prevention and interconnected.

A radio room in the general office maintains constant contact with other camps, airlines and weather stations.

A saw mill will be set up close to the river since the mine will need a fair amount of timber. Cost of local spruce is high, varying from $85 to $110 per thousand board feet. Logs cost 14 to 17c per running foot. During construction of the camp, logs and lumber were supplied by local lumber camps.

Electric power is generated by two 600-kw, I-R diesel units. Standby is a 100-kw International. Power is transmitted as 2300v, 3-phase, 60-cycle, with substations located where needed.

Mine air is supplied by an 800-cfm, I-R (XLE), electric drive compressor. Standby is a Gyroflow. Both units have given excellent service to date.

Every consideration has been given to avoiding costly breakdown delays through much equipment duplication. DeCoursey-Brenwis is confident that Red Devil will be a successful mercury producer.

ALFRED M. PENHALE, outgoing CIMME president presents International Nickel Co. award to C. G. McLachlan, general superintendent of mills, Noranda Mines.

CYRUS EATON tells the convention that Canada needs more capital for mining.

CIMME Probes Engineering Shortage

AN OPENING SESSION of the Canadian Institute of Mining & Metallurgical Engineers at the Chateau Frontenac on Sunday, April 8, in Quebec City, may well have been one of the most significant of the convention. Modestly listed as "An Open Forum on Education," this session really should have been entitled "Where Are We Going to Find Our Future Mining Engineers?"

Chairmanned by Prof. A. V. Corlett of Queen's University, assisted by W. R. MacClelland of the Mines Branch, this session explored the very core of the problem and came up with some conclusions which show that the Canadian mining industry, educators and government agencies are attacking one of mining's greatest responsibilities with increasing vigor.

Mr. McClelland conducted a survey of 18 Canadian colleges which showed that the available supply of mining, metallurgical and geological engineers for 1956, 1957, 1958 and 1959 will not keep pace with the fast expanding Canadian mining industry.

Dr. Horace G. Fraser, vice president and general manager of Falconbridge Nickel Mines, Ltd., introduced by the chairman as a former educator now serving in industry, summarized the situation in part as follows:

The shortage is not confined to Canada. It is world-wide. The shortage is not confined to mining alone, it is present in all technical fields. The shortage is due to five factors: 1. Wartime dislocations which prevented mining engineers from pursuing normal educational careers. 2. Postwar dislocations which forced some young men to give up educational plans, and take any job just to make a living. 3. The curtailed birth rate during the depression is now being felt. 4. Canada's mining industry has gone through "an almost explosive expansion" during the past 10 years. 5. We are moving "into an engineering age" during which educational standards are becoming more difficult, and specialized. Recognizing these factors, Dr. Fraser advised the audience, "we should not get too perturbed over the short-term outlook."

Dr. Fraser outlined two approaches to the problem: a short-term program, and a long-term program. At present, he said "We are seriously underusing" our organizations. "Why," he asked "are some of our engineers doing drafting and sampling which are jobs way below what they have been trained to do?" He also suggested that "we draw in and utilize people with limited technical ability to do jobs requiring only limited ability." He strongly urged use of people trained in technical and trade schools such as the Haileybury school. Speaking of salaries, he said "we must make the perquisites of engineering profession attractive enough to pull students into this field." Citing that engineers at times may receive only two to two and one-half times as much pay as a union-protected ditch digger, he suggested that our industry may be way out of balance "on our compensation and our use of engineers." The present shortage, he said "is seriously threatening to curtail our present expansion."

On a long-term basis, he pointed out that the present crop of war babies will help to increase the supply. However, he expressed concern over the lack of space and facilities of all universities, and the financial problems that confront these institutions, and said "that industry will have to come to the aid of universities." But, he quickly added, a single company does not want the job of having to decide which university or which department of a university is entitled to aid. This will have to be done by some coordinating group which can decide wisely (and without pressure) where college aid should be allocated. He advised universities to give more clerical assistance to professors and relieve them from some of the "file-clerk" jobs they have to perform to get things done. Dr. Fraser advised a reappraisal of our educational systems, decrying the fact that many a student of limited abilities was discouraged completely from entering mining because of mid-year flunk-outs. "Perhaps," he suggested, "we're over-educating the average student, and under-educating the masses that attend school." He said that industry can train those who have had only a partial training and is willing to do so. He questioned whether scholarships were the best answer to the financial problems of students, pointing out that many of them have gone begging. As a final suggestion, he said industry might go to the high

schools, pick out likely students for engineering upon advice of teachers and give them scholarships to help them through the university.

Dr. Morrison, of McGill University, estimated that 150 to 200 engineers would be needed each year just to replace those lost through death and retirement. Current supply to the profession is barely keeping up with this requirement, and fails to meet the needs of a rapidly expanding industry. Compared with offers made to graduates in the civil, electrical and mechanical fields, he said the "mining engineering profession does not show up too good." Because of the remoteness of the areas in which mining engineers have to work and other aspects, he concluded that salaries will have to be more attractive.

Audience response to the talks was lively. A suggestion was made from the floor that the Canadian Broadcasting Commission be provided with ideas and information to telecast the mining industry to young prospective engineers. Feeling was quite general that the mining engineer is underpaid. One comment—"The reason that engineers' salaries are low is that they are determined by engineers."

Despite the fact that four to six technical sessions were going on simultaneously during most of the meeting, attendance at the sessions was high, and audience participation instructive and excellent.

Ground Stresses Discussed

In a symposium on ground stresses, A. V. Corlett, head of the Department of Mining, Queen's University, reported that an average of one rock bolt was used for each 132 tons of ore mined in Canada in 1955. Twenty seven per cent of the mines using rock bolts produced about 50 tons of ore per bolt. In the same session, Stefan Boshkov, instructor of the School of Mines, Columbia University, reviewed methods used to analyze underground mine stress problems. One approach to the problem is theoretical, the other is based on accurate observation and recording of rock stress phenomena. He suggested that these two approaches be bridged by field of model studies, and gave elaborate mathematical evidence to establish this point.

In a paper prepared by A. J. Roux, H. G. Denkhaus and E. R. Leeman, of the National Mechanical Engineering Research Institute, South African Council for Scientific and Industrial Research, emphasis was placed on the determination of ground stresses by photoelastic analysis—in fact it was stated that this may be the only practical solution where mine openings are of complicated geometrical shape. A strain gage, designed to be cemented in drill holes, was described. The authors reported that a research program has been started to work out some of the unsatisfactory aspects of model analysis.

During comment which ensued, a staff member from the Cleveland-Cliffs operations at Ishpeming described methods used to study ground failure at the underground property. Subsidence pins, geophones, calipers and bore-hole cameras were mentioned as possible devices. He reported that caving methods under 3,000 ft of cover involving 122 acres of undercut had resulted in 120 acres of surface subsidence—rather strong evidence of the vertical development of shear planes over caved ground. Question was raised as to whether the 2 foot-tons of energy release per cubic foot during a rockburst was "a reasonable figure." Opinion from the panel indicated that this classic figure needs more investigation. Opinion also seemed quite general that the mining industry "is just scratching the surface" when it comes to solution of ground stress problems.

Other papers presented at this session were "Soil Mechanics Applied to Rock Failure" by Dr. R. G. K. Morrison; "Ground Control at Depth, Transvaal and Orange Free State Goldfield" by C. J. Irving, consulting engineer, Johannesburg, S. A.; and "Some Experiences in Investigating Stresses and Forces in Massive Structures" by W. L. Gibson, engineer, Hydro Electric Power Commission of Ontario. The symposium on ground stresses was chairmanned by John Convey. H. R. Rice, professor and head of the Department of Mining Engineering, University of Toronto, was moderator.

Many excellent milling and metallurgical papers were presented at the meeting. One symposium of particular interest was that covering milling's hottest subject—the hydrocyclone. D. B. Smith, superintendent of development and technical control, Sullivan concentrator, British Columbia, cited the following advantages for hydrocones used to filter lead concentrates: (1) Over-all moisture content of the concentrates was lowered resulting in appreciable freight savings. (2) Physical characteristics of the concentrates have been improved, thus cutting down shipping losses from hopper-bottom freight cars. (3) Operating and replacement part costs have been low on the hydrocones. H. A. Steane and G. A. Ekins of Canadian Exploration, Ltd., described the use of two Dorr-Clones in a zinc middling regrind unit at the Salmo, B. C., lead-zinc mill. The regrind was carried out at 325 mesh to liberate sphalerite particles from composite particles of sphalerite in calcite. This system resulted in an increase in grade of zinc concentrates of at least three per cent.

G. E. Viens, R. A. Campbell and R. R. Rogers, of the Mineral Dressing and Process Metallurgy Division, Department of Mines and Technical Survey, presented a paper showing that iron, manganese-iron, titanium-iron, nickel and chromium-iron ores can be treated beneficially in an electric smelting furnace. The Department of Mines has been operating an experimental 250-kva electric smelting furnace at Ottawa to develop this information.

When in full operation, International Nickel Co.'s iron ore recovery plant will treat 1,000 tons of pyrrhotite daily to produce some 250,000 tons of iron ore per year, according to a paper prepared by the staff of INCO and presented by Paul Queneau, assistant to the vice president of the company. First large-scale shipments from the plant have run 68% iron.

Capital Is Needed

At the Institute's annual banquet, guest speakers were the Honorable Maurice L. Duplessis, Premier of Quebec, and Cyrus S. Eaton, chairman of the board, C. & O. Railway. Both speakers were in agreement that outside capital is necessary to develop and expand Canadian industry. Premier Duplessis stated that "Foreign capital, whether it come from France, Great Britain or the United States, will always be welcome. Capital means investment without which progress is impossible." The Premier cited the great shortage of technical help in the mining industry and appealed to the monied classes of industry to come to the aid of university students and technical schools. He said that it was the responsibility of industry, and not the government, to invest in universities.

Cyrus Eaton stated that "Money is simply not available in adequate amounts from private and public sources in Canada to meet the Gargantuan demands of the many mines to open, factories to erect, oil wells to drill, roads to build, railroads to extend, airports to construct, harbors to improve, rivers to be made navigable, telephone lines to string, and water powers to harness.

John Fortune Walker, Deputy Minister of Mines, British Columbia, was elected president of the Canadian Institute of Mining. He succeeds Alfred H. Penhale. The medal of International Nickel Co. of Canada was presented to C. G. McLachlan, general superintendent of mills at Noranda Mines, for his achievements in the science of milling Canadian ores.

LOOKING FORWARD to two-day session, 150 professional men, prospectors and lawyers reported to registration desk.

GUIDING THE PROGRAM were E. J. Mayhew, symposium dean, at left, and Clement K. Chase, sub-section chairman.

Feed materials, resin-in-pulp, mine development, ore genesis, uranium stocks and field trips to mine and mill keep things humming . . .

. . . At Moab AIME Uranium Session

FIRST MAJOR MINING meeting ever held in Moab, the Uranium Symposium sponsored by the Moab Chapter, Uranium Sub-section, Utah Section AIME, got together there on April 6 and 7. The two day session featured a welcoming luncheon, four papers and dinner on Friday. On Saturday, two papers and field trips followed a breakfast. Clement K. Chase, chairman and metallurgist for Uranium Reduction Co. said that the idea will be repeated next April.

Dean of the symposium was E. J. Mayhew, consulting geologist and general manager of Apex Exploration Co. Field trip on Saturday took the group to the $8-million mill now under construction at Moab by Uranium Reduction Co. Later in the day, the group was split into two sections for mine field trips. One group visited the Homestake Mining Co. and Hecla Mining Co.—Federal Uranium Co. shafts. The other group went to Utex Exploration Co. and Standard Uranium Co. properties.

"Solvent Extraction of Uranium from Acid Leach Liquors and Pulps" was the subject of a paper read by J. B. Clemmer, chief, USBM, Salt Lake City. Paper was prepared by Clemmer, J. R. Ross and J. B. Rosenbaum. After the reading, questions from the audience were answered by J. B. Rosenbaum. Solvent extraction is low cost and routine.

Joseph W. Joyce, chief metallurgist, National Lead Co., Inc. and Helmer A. Johnson, metallurgical engineer, Galigher Co., presented paper entitled, "The U.S. Atomic Energy Commission Monticello Acid Leach Plant." Paper discussed in detail the newly installed resin-in-pulp extraction process. Method went onstream last November, is sound, practical and economic.

The authors discussed the acid plant flowsheet expansion at the Government-owned mill. Resin-in-pulp process was designed under the supervision of National Lead Co. Galigher Co. designed the grinding and leaching section of the mill. These two companies teamed up to provide engineers and operators on the start-up program. Design capacity was reached within ten days.

Paper describes the water grinding-classification circuit, agitated acid leach, sand-slime separation, resin-in-pulp, elution, precipitation and double steam drying. At AIME anual meeting in New York last February, they reported on Monticello's carbonate unit.

Third paper on Friday was presented by James Quigley, vice president, Continental Development Co., Eureka, Utah. Subject covered was "Development of Uranium Mines."

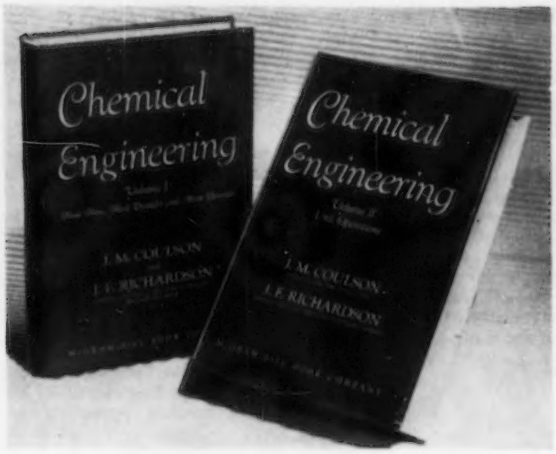
In last session on Friday, Kenneth A. Phillips, assistant chief metallurgist, American Zinc, Lead & Smelting Co., East St. Louis, Ill., urged industry to get into the feed materials end of the uranium industry. His paper was entitled, "Industrial Participation in the Production of Refined Uranium Compounds." (See *E&MJ*, January 1956, Feed Materials.) According to Mr. Phillips, companies entering the field now won't make much profit at the start, but will be in on the ground floor of a business with tremendous potential.

After Saturday breakfast, Dr. Charles A. Rasor, chief, procurement branch, mining division, AEC, Grand Junction, presented "Ore Genesis of the Black Uranium Ores of the Colorado Plateau." Dr. Rasor said that information gained since Charles A. Steen's discovery in the Big Indian Wash will someday lead to similar discoveries in other areas.

Robert W. Bernick, business manager, *Salt Lake Tribune*, in the final paper, spoke frankly about the uranium penny-stock market promotions. Mr. Bernick feels that penny stocks are not so bad; if the money goes into the ground for exploration, development and mining, instead of for airplanes and station wagons for the promoters.

The field trips wound up the symposium. If interested in copies of any of these papers, we suggest that you contact Clement K. Chase at Uranium Reduction Co., Moab, Utah.

NEW BOOKS



Chemical Engineering, Volume I, Fluid Flow, Heat Transfer and Mass Transfer, by J. M. Coulson and J. F. Richardson. Second revised printing of this unit process text book covers energy relationships, friction in pipes and channels, flow measurements, chemical pumps, heat transfer, mass transfer and momentum. Additional sections deal with heat and mass transfer, boundary layer, humidification and water cooling. Published in Great Britain and the U. S. as listed below. Text, plates drawings and a problem section in 374 pp. Price $7.50.

Chemical Engineering, Volume II, Unit Operations, by J. M. Coulson and J. F. Richardson. First edition. Text book covers many subjects including fluid beds, packed towers, filtration, centrifugals, particle motion, thickening, conveying and fluidizing. Additional sections discuss distillation, gas absorption, evaporation, drying, particle size reduction, classification and mixing. Published in Great Britain by Pergamon Press Ltd., Maxwell House, Marylebone Road, London, N. W. 1, and in the U. S. by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 961 pp. Price $9.

● Application for the following free literature should be made to the address below. Because of the limited editions only one copy of any particular edition can be sent to any one person and only a modest number of a variety of publications can be furnished to an applicant. Please order only those publications actually needed. Publications Distribution Section, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa.

Circular 7729, Marketing Sheet Mica, by Robert D. Thomson. Milling, preparation and marketing of an important material for electronic and electrical equipment. 20 pp.

Circular 7731, Tungsten Potential of the San Juan Area, Ouray, San Juan and San Miquel Counties, Colorado, by Carl Belser. 18 pp.

Report of Investigation 5158, Synthetic Mica Investigations VII, by H. R. Shell and R. L. Craig. Chemical analysis section. 30 pp.

Report of Investigation 5169, Production of Hafnium, by H. P. Holmes, M. M. Burr and H. L. Gilbert. Tonnage quantities of metal were produced by Kroll process equipment. Photos, tables and 32 pp.

Report of Investigation 5170, Ilmenite Concentrates from Valley County, Idaho, by L. H. Banning, W. F. Hergert and D. E. Halter. High titanium slag and a good pig iron were produced in dry-top electric smelting tests. Photos, tables and 18 pp.

Report of Investigation 5172, Concentration Tests on California Chromite Ores, by A. L. Engel, E. S. Shedd and E. Morrice. 10 pp.

Report of Investigation 5173, Manganese Explorations in Philipsburg District, Granite County, Montana, by J. S. McNabb, Jr. 25 pp.

Report of Investigation 5175, Experimental production of High Purity Cobalt, by K. K. Kershner, F. W. Hoertel and J. C. Stahl. 12 pp.

Report of Investigation 5177, Investigations of Copper-Nickel Mineralization in Kawiskuwi River Area, Lake County, Minnesota, by W. A. Grosh, J. W. Pennington, P. A. Wasson and S. R. B. Cooke. Satisfactory flotation of low grade ore was obtained. 18 pp.

Report of Investigation 5181, Oxidation Rates of Molten Metals as Determined by Recording Thermobalance, Part I, Tin, by J. H. Bilbery, D. A. Wilson and M. J. Spenlone. 24 pp.

Report of Investigation 5187, Preliminary Investigation of the Takelma-Waldo Copper District, Josephine County, Oregon, by R. J. Hundhausen. 22 pp.

Minerals Yearbook, Area Reports, Volume III, 1952, by the Bureau of Mines. The yearbook has grown over the years to such an extent that it has become necessary to add a new volume to the report. Volume I, Metals and Minerals; Volume II, Fuels; and now Volume III, Area Reports, which covers the U. S. by state and county. 1,018 pp. Price $3.75.

Reports and Bulletins

Geology and Mineral Deposits of the Potgietersrus Tin Fields, by C. A. Strauss. This is Geological Survey Memoir No. 46 as published by the Union of South Africa Department of Mines, Pretoria. 204 pp. Price 20/.

Report No. 8, Geology of the Horseshoe Rapids Area, Lower Hamilton River, Labrador, by T. Podolsky for the Department of Mines and Resources, St. John's, Newfoundland. Map and 26 pp.

Geology of Godfrey Township, by Nelson Hogg. Volume LXIII, Part 7 published by the Ontario Department of Mines. Maps and 52 pp.

The Legal and Moral Basis of the Right to Work Laws, by J. C. Gibson. Publication of a speech given before the American Bar Association. Distributed by the National Right to Work Committee, 35 Rust Building, Washington, D. C.

Annual Report of the Department of Mines, 1954. Department of Mines, Halifax, Nova Scotia. Data sheets and 123 pp.

Annual Report of the Under Secretary of Mines. Reports of Wardens, Inspectors of Mines, Government Geologists and other officers for the year 1954. Brisbane, Australia. Tables, plates and maps in 147 pp.

65th Annual Report, Year 1954. Transvaal and Orange Free State Chamber of Mines. Box 809, Johannesburg. 149 pp.

Announcement No. 46. Chemists, Mathematicians, Electronic Scientists, Metallurgists and Physicists. Publication by the U. S. Civil Service Commission, available from the Commission, National Bureau of Standards, Washington 25, D. C. Details positions available in the Washington area for technical trained men and women. No closing date has been set for application. Plenty of positions are open and available.

Geology of the Montreal River Area, by E. W. Nuffield. Published by the Ontario Department of Mines, Toronto. 30 pp.

Geology and Mineral Resources of the Salmon River Quadrangle, Lemhi County, Idaho, by Alfred L. Anderson. Pamphlet No. 106. Published by Idaho Bureau of Mines and Geology, Moscow. 102 pp.

Special Report No. 49, Radioactive Deposits of California. Published by California Department of Natural Resources, Division of Mines, Ferry Building, San Francisco. 38 pp. Price 50c.

Volume 51, No. 4, October 1955, Mines and Mineral Resources of San Mateo County, California. Published by the California Journal of Mines and Geology, Division of Mines, Ferry Building, San Francisco. Maps and 165 pp. Price $1.

Bulletin 25, Silica Resources of Clark

County, Nevada, by Thomas D. Murphy for the Nevada Bureau of Mines, Reno. 28 pp. Price 60c.

Geology of Monteagle and Carlow Townships, by D. F. Hewitt. Published for the Ontario Department of Mines by Baptist Johnston, Printer to the Queen's Most Excellent Majesty, Toronto. Maps and 73 pp.

Report No. 32, Geology of the Taveta Area, by L. M. Bear. Geological Survey of Kenya, Government Printer, Nairobi. Maps and 47 pp. Price 12/50/.

Report No. 33, Geology of the North Kitwi Area, by R. G. Dodson. Nairobi, Kenya. Maps and 27 pp. Price 8/.

Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy. Volume I, 155 pp. Volume II, 749 pp. Printed for the Committee by the U. S. Government Printing Office, Washington, D. C.

Tungsten, by Mildred Givin Andrews. Published by Tungsten Institute, 1757 K Street, N. W., Washington 6, D. C. Pamphlet. Illustrated, 28 pp. Price $1.50.

Israel Economic Forum, The Mineral and Water Resources of Israel. Published in Adar, Israel, by the Ministry of Commerce and Industry and the Bank Leumi Le-Isreal, B. M. In English. Price IL 1.500. 151 pp.

Better Metal, Cheaper Methods Guide London Meeting

HALOGENATION AS A MEANS OF REFINING some of our rarer metals, was the keystone of the Symposium on the Extraction Metallurgy of the Less Common Metals at the Lecture Hall, Royal Society of Arts, on March 22-23. Sessions covering extraction of uranium, thorium, columbium, tantalum, vanadium, tungsten, titanium and beryllium stressed the chlorine and fluorine route to produce better metal. Other sessions concerned the Oroya smelter, ion exchange, solvent extraction and the production of hafnium-free zirconium. The following is a resume of the papers presented. They will be published with discussion added in a bound volume by the Institute of Mining and Metallurgy, 44 Portland St., London, W. 1.

Some General Chemical Principles in Extraction of Metals from Low-grade Ores, by A. J. E. Welch. Paper is a review of some of the recent processes in which chemical concentration methods predominate. References. 9 pp.

Purification by Solvent Extraction, by J. M. Fletcher. Merits of solvent extraction are compared with those of other methods Examples are given using tributyl phosphate as solvent. References. 15 pp.

Studies in the Chlorination of Some Complex Ores—Wolframite, Vanadinite and Chromite, by E. A. Pokorny. Wolframite can be chlorinated and separated from low grade ore. Vanadium can be produced by this method, but in the case of chrome, cheaper methods are available. 13 pp.

An Oxide-Chloride Conversion Process for the Extraction of Certain Metals, by A. R. Gibson and J. H. Buddery. Reference is given to treating uranium and thorium ores. Photographs. References. 17 pp.

Metallurgical Developments in the Recovery of Some of the Less Common Metals in Canada, by L. E. Djingheusian, Mines Branch, Ottawa. Briefly discusses columbium-tantalum at Boreal Rare Metals, lithium from spodumene of Cat Lake origin and selenium-tellurium at Inco. 19 pp.

Extraction of Some Less Common Metals from Smelter and Refinery Intermediates at La Oroya, Peru, by A. K. Schellinger. Review of the commonly-used extraction methods for selenium, tellurium and thallium. These metals are recovered from slag, dust and fumes at Oroya. References. 8 pp.

The Chemical and Physical Concentration of Uranium Ores, by S. W. F. Patching. References. 12 pp.

The Recovery of Uranium from Sulphate Leach Solutions by Anion Exchange, by T. V. Arden. Photographs. References. 9 pp.

Factors Influencing the Magnesium Reduction of Uranium Tetraflouride, by J. Harper and A. E. Williams. Technique is described which gives high density uranium metal with over-all high reduction efficiency. Photographs. References. 22 pp.

Pilot Plant Concentration of Mindola Uranium Ore, by M. L. Fitzgerald and D. F. Kelsall. Pilot plant at Rhokana Corp. developed combination gravity and flotation method on 10-tpd scale. Flowsheets. 10 pp.

Processes for the Extraction of Vanadium, by C. Tyzack and P. G. England. Describes extraction of ductile vanadium by oxide and halide reduction. Calcium reduction and a method for producing metal in powder form by chlorination and hydrogen reduction are also detailed. Photographs. References. 30 pp.

The Production of High Purity Vanadium Metal, by E. Foley, M. Ward and A. L. Hock. Past practice is reviewed and method for producing 99.7% pure vanadium by chlorination method is discussed. Photographs. References. 16 pp.

Flotation of Vanadium Ore from the Abenab West Mine of the South West Africa Company, by M. G. Fleming. Laboratory results and their application in 250-tpd plant are described. References. 28 pp.

The Selection of a Process for Development for the Production of Pure Niobium, by G. K. Dickson and J. A. Dukes. Reviews chemistry of five separation methods for producing pure columbium. Methods discussed are fluoride, alkali attack, solvent extraction, potassium columbate from columbic acid and chlorination of ferrocolumbium. 14 pp.

The Extraction of Pure Niobium by a Chlorination Process, by A. B. McIntosh and J. S. Broadley. Production of columbium from ferrocolumbium by chlorination and hydrogen reduction.

Distillation of Volatile Chlorides as a Means of Obtaining Pure Niobium, by B. R. Steele and D. Deldart. Discusses equipment and theoretical data required to separate columbium from tantalum, tungsten and iron by fractional distillation. Pure columbium can be made. 8 pp.

Beryllium Production at Milford Haven, by P. S. Bryant. Modification of the Copaux method for the production of beryllium hydroxide is described. 13 pp.

The Preparation of Beryllium Metal by Thermal Reduction of the Fluoride, by D. A. Temple and L. J. Dereham. Pilot plant method has been developed. Method starts with pure beryllium hydroxide. Control of health hazard of the process and prevention of contamination of the beryllium are described. Photographs. References. 14 pp.

Purification of Metals by Intermediate Formation of their Stable Halide Vapours with Application to Beryllium and Titanium, by P. Gross and D. L. Levi. Conditions of the reaction and factors influencing purity of beryllium and titanium are described. References. 10 pp.

The Extraction of Thorium From Monazite, by A. Audsley, R. Lind and P. G. England. Number of processes for producing thorium metal from rock are detailed. Chlorination method is presented. Photograph. References. 29 pp.

Some Investigations into the Extraction of Titanium by Fused Salt Electrolysis, by F. L. Bett, B. S. Hickman, G. M. Willis and H. K. Worner. Paper discusses electrolytic titanium and work done at the University of Melbourne. Photographs. References. 15 pp.

The Manufacture of Hafnium-Free Zirconium, by F. Hudswell and J. M. Hutcheon. The U. S. method, the Russian method and a suggested method are presented. Flowsheet. References. 12 pp.

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Mineral Hearings Indicate Compromise

SHOWDOWN on the drawn-out battle over U. S. longe-range minerals policy came to a head on Capitol Hill late last month, when Industry and Government witnesses laid their cases on a Senate Interior Mining Subcommittee hearing table. The five days of testimony give a detailed but sweeping picture of what producers and operators want, what they are likely to get in the way of Government support:

(1) Broad price support programs aimed at keeping mines in business for the sake of maintaining a "healthy" over-all domestic mining industry are out.

(2) Interior Department will step in to help specific materials keep competitively abreast of the world market until they can go it on their own, but only where the Government sees a long-range need for a domestic supply of these materials and a good chance these industries can "stand competitively alone without artificial stimuli."

This is the compromise Washington observers have been anticipating. In terms of specific materials and specific legislation now in the Congressional hopper, it points up some significant developments.

For one thing, it means that tungsten —and probably manganese and columbium-tantalum—will continue to get Government price supports to assure domestic supply. It also means Interior will look for other ways of giving what Assistant Secretary Felix Wormser calls "moderate" protection to other commodities after present ODM-GSA strategic stockpile purchases programs expire. This help will come in diverse programs worked out at the suggestion of the President's Minerals Policy Committee —including exploration and technical production development aid from DMEA, Geophysical Survey Service, Bureau of Mines labs and pilot plants. Another step will be a willingness on the part of the Administration to consider moderate import duties on such commodities as lead and zinc after current stockpile goals are reached, though heavy new tariff restrictions are out of the question in light of both political parties' stand on international trade cooperation.

Another Government "aid" lies in the Commodity Credit Corporation's authority to barter agricultural surpluses for foreign minerals for the supplemental stockpile, according to Wormser. Often, the Government can thus draw off world surpluses, help maintain world price levels.

Two more moves that wouldn't cost the Government any direct expenditures were pointed out—continued tax depletion allowances and less restrictive Pentagon orders on military uses of some of the new "atomic" materials such as columbium-tantalum, titanium, and the like.

Like any compromise, the new Administration emphasis on a directed long-range policy isn't dramatic; isn't all industry witnesses asked. It will probably take a little additional legislation. Interior Committee chairman James Murray (D. Mont.), backed by ranking GOP Senator George Malone (R-Nev.) and other bi-partisan sponsors, are pushing bills to extend the individual ODM-GSA purchase programs for seven basic strategic minerals, plus new ones for antimony and mercury, set up an Interior Department price support program for these metals, or establish an Interior Department Commission to formulate an over-all policy program. These are the bills on which the hearings were held.

The industry witness list read like a Who's Who in Mining. More than three dozen mine owners, operators, and processors, plus some technical witnesses came to Washington to make their case.

They covered the multitude of problems facing their industries today: Foreign competition and Government resistance to developing new domestic sources and uses headed their bill of particulars against the Government. Each of the mine operators of the seven minerals now benefitting from stockpile purchase programs testified that the operations would suffer if Washington didn't come to their aid. Many said they weren't wedded to any one solution, but all favored the continuation of the purchase programs.

A basic charge was that the U.S. is still operating under a philosophy of "conserving" domestic minerals while buying abroad. Sen. Malone and several industry witnesses repeatedly attributed this to a hangover from the "subversive" thinking of former Assistant Treasury Secretary Harry Dexter White during the often-bitter testimony.

Interior Department witnesses, led by Wormser, based their answering testimony on the argument that a free competition is the only climate in which a business can stay healthy. Continuation of purchase programs or other supports just for the sake of keeping mines open, they said, is expensive and unnecessary. They also argued that each commodity should be dealt with in light of its own place in the over-all picture—hence the green light for tungsten and high-grade manganese.

Government witnesses also discounted some industry testimony that new domestic sources are not being explored because of Government restrictions, and that a close-down of uneconomic mines would hurt employment and the economy in certain localities. Some minerals may develop to the point of domestic self-sufficiency, but not all, they held.

After the Senate Committee makes its report, the same battle will be waged on the House side this month. Here again, industry's case will be argued by many of the same witnesses.

Among those who testified before the Senate group were W. Lungsford Long, president of the Tungsten Institute and Manganese, Inc.; K. C. Li, chairman of the Wah Chang Corp.; Sam H. Williston, Cordero Mining Corp.; J. Carson Adkerson, president of the American Manganese Producers Association; Sam Phillips, president of Domestic Mica Miners Assn.; also many individual mine owners, operators, and technicians.

Capitol Hill Alarmed by Nickel Scarcity

CHARGES of a "black market" price have thrown the Washington spotlight on the continuing shortage of nickel. Government officials and Congressional spokesmen are hopping as a result of industry pressures to "do something." Office of Defense Mobilization director Arthur S. Flemming calls it "one of our toughest problems."

The long-range answer, Flemming feels, is bright on the horizon: Development of new techniques for recovering more nickel from low-grade ores. The ODM chief told Congress and reporters recently that he has high hopes for processes now being developed in Cuba by Bethlehem Steel Co. and Freeport Sulphur Co. But he admits that these won't ease the current pinch for some time to come.

Meanwhile, here's what has been happening:

Defense and military demands have been going up as fast as ODM can defer GSA stockpile purchases to release more nickel for private industry. Civilian demand is climbing apace with military needs, with the result that production facilities simply can't keep up, despite sharp step ups.

Commerce Department's Bureau of Defense Services Administration has estimated that the total U. S. requirements —military and civilian—will reach 300-million lb this year. GSA has deferred stockpile purchases of over 22-million lb through the first half of 1956, and boosted its Nicaro, Cuba, output to more than 30-million lb per year. But as fast as these steps were being taken, Flemming says, military demands went up at a similar rate.

Commerce's Bureau of Foreign Commerce has banned nickel scrap exports;

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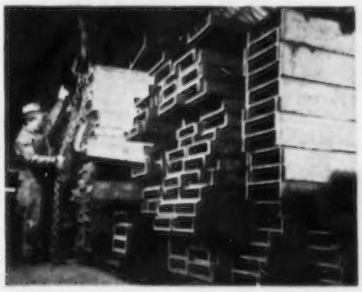

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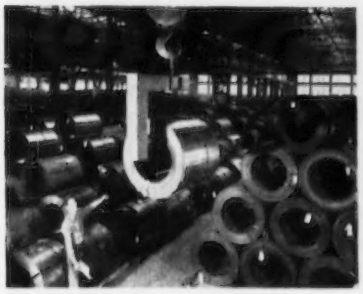

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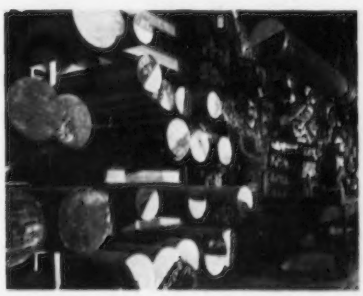

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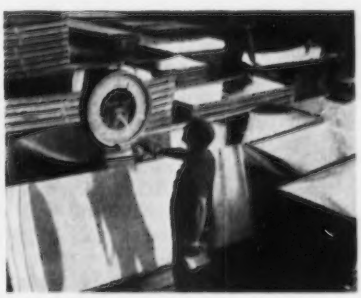

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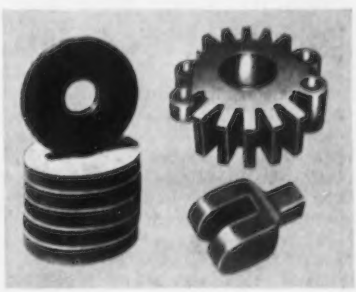

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Flemming has ordered a market study by John R. Townsend, materials director of the Samdia Corp.

But what really touched off the current situation are charges on Capitol Hill that private users are having to pay "black market" prices as high as $2.50-$3.00 per lb for 64½c nickel. House majority leader John McCormack (D-Mass.) first called attention to this situation on the floor after receiving complaints from Col. Willard Rockwell, board chairman of Rockwell Spring & Axle Co. Sen. Homer Capehart (R-Ind.) followed up these complaints by suggesting a Congressional investigation at recent hearings before the Joint Congressional Defense Production Committee.

Flemming denies there can be a "black market" situation existing where there are no Government controls. He points out that ODM lifted nickel controls late in 1953, and has been doing what it can to ease the situation ever since.

However, BDSA is currently studying reports of defense-rated contractors getting more than their fair share of nickel and reselling it at higher prices, is expected to make a report soon. Meanwhile, BDSA has cracked down on military orders, requiring each to be checked by BDSA for "essentiality."

Flemming says there will be no change in ODM's basic short-range nickel policy. He says the emergency stockpile isn't filled, and that none of the metal will be released from the pile. GSA will continue to defer purchases but won't discontinue until the goal is reached. If Congress wants to investigate, Flemming says, he would not object—"It might be well to get the facts on record." Pending the outcome of BDSA, Samdia, and/or Congressional probes, the solution lies with new processes such as Bethlehem's and Freeport's, says the ODM chief.

Security Made Base for Protective U. S. Tariffs

TARIFF PROTECTION is now being sought on grounds of national security alone. While this has always been a Tariff Commission consideration in deciding industry appeals for relief, industry can turn to ODM on this basis alone, under a legislative rider to last year's Reciprocal Trade Agreement Act amendments.

Recently, U. S. watch makers asked further tariff restrictions on the grounds imports from Switzerland are hurting the war-sensitive timing-device industry. (U. S. watch makers recently won a tariff hike on imports from the Commission and the White House.) Under the new law, industry can ask ODM to investigate, hold hearings and make further recommendations to the President. ODM agreed to look into watches, will also investigate fluorspar according to director Flemming. (Fluorspar industry recently lost a relief appeal to the Commission and the President.)

Labor This Month

1956 BARGAINING—THE TOUGHEST EVER: That's the threat facing the nonferrous industry as the International Mine, Mill and Smelter Workers Union prepares for mid-summer bargaining. With negotiations still three months off, Mine-Mill officials are already getting set for a heated battle. Demands are set, talk of striking is prominent.

Advance predictions indicate a strike is a good possibility. It's not just the usual labor-management battle. MMSW is fighting an interunion war with the AFL-CIO Steelworkers over bargaining rights in the industry. The outcome of this union conflict hinges on the success in bargaining of both unions. Both Mine-Mill and the Steelworkers are shaping their demands in this light and the union that gets the most will also probably rack up the biggest successes in the membership war.

NON-FERROUS MANAGEMENT IN THE MIDDLE: Caught between the union crossfire, copper companies will face an adamant union at the bargaining table. Mine-Mill officials will have one eye on contract settlements in the steel industry, and will insist on better terms. To check raiding attempts by the Steelworkers, MMSW officials say their union must be prepared to "strike as long as necessary or take whatever other steps might be necessary." They don't spell out these other steps.

But, one look at the demands of both unions shows any settlement even close to their terms will be costly. The Steelworkers, bargaining in June, are asking at least a 30c "package," including supplementary unemployment payments and overtime pay for weekend work. Mine-Mill demands, which the union insists will not be scaled down in negotiations, are much higher. Here they are:

A 20c-an-hour pay raise. MMSW claims that "rarely, if ever before, have the companies been so able to meet our demands."

A 75c hike in pension credits to $2.50 a month, with earlier retirement for underground workers. Also, the union will press extension of the Kennecott welfare plan to other companies.

A renewal of last year's demand for $60 a week pay for 52 weeks to make up lost working time through occupational illness, unemployment or illness or accident not suffered on the job. Any other insurance payments would be included in the $60 figure.

Besides these industry-wide demands, MMSW will seek to eliminate the 2- to 3c southwestern area wage differential and boost all holiday, vacation and shift differential pay to the highest level in the industry.

With these demands on the record, MMSW officials say they will be impatient bargainers; that they'll insist on a quick settlement or a general shutdown may be ordered.

NEW PEACE OVERTURES TO AFL-CIO: While Mine-Mill is readying its last-ditch fight, its officials are making new overtures to join the recently-formed AFL-CIO. The hope is to get into the federation, either as an autonomous union or part of another big international. Success in this project would fend off the Steelworkers, already allied to the AFL-CIO.

But, there's no chance that the AFL-CIO will let the mine union join up, in view of its reputation as a left-wing union and its previous expulsion from the former CIO on Communist-domination charges. To be admitted, Mine-Mill would have to rid itself of left-wing leadership. Taking a short step in the direction, former MMSW secretary-treasurer Maurice Travis, now a West Coast organizer for the union, will retire next month. However, the break won't be complete. Travis, who is now appealing his conviction for filing a false Taft-Hartley non-Communist oath, will retire from the union on a $300-a-month disability pension. The only likely way for Mine-Mill to join the AFL-CIO is through absorption, and that will happen only if Mine-Mill should fail in its inter-union dispute.

FEDERAL WELFARE CLEANUP STALLS: The proposed law in Congress to wipe out mishandling and corruption in multi-billion dollar welfare and pension programs has struck a snag—and the new bill may not get through Congress. There's major resistance by management to full disclosure of fund operations. Influential companies don't want to reveal their investments of fund monies or other so-far private affairs.

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PERSONALS

PAUL GEMMILL has been named general manager of Utah and Nevada operations of Combined Metals Reduction Co. He served as plant manager for CMR at Pioche, Nev., since October 1954, and was previously general superintendent of mines in Nevada. Other posts include superintendent of Prince Consolidated Mines Co. and Bristol Silver Mines, all Pioche district lead-silver-zinc producers. In 1954, Mr. Grimmell served as Nevada section chairman of the AIME.

A. J. Cayia, former vice president and general manager, has been elected president and general manager of Caland Ore Co., Ltd., Canadian iron ore mining subsidiary of Inland Steel Co. Mr. Cayia is also president of Inland Lime & Stone Co., the steel company's limestone division near Manistique, Mich. **P. D. Block Jr.,** formerly president of Caland, has been elected chairman of the board, succeeding **Clarence B. Randall** who retired from the chairmanship of the steel company and its subsidiaries under the company's retirement program.

Gill Montgomery, serving the company as general manager of its Fluorspar Division at Eldorado, Ill., since 1952, has been advanced to the position of vice president of Minerva Oil Co. in charge of the Fluorspar Division. Additions to the fluorspar mining and milling staff within recent months include **Jerome J. Daly,** formerly with Atlas Diesel Corp., as mining engineer; and **William Rule,** formerly a metallurgist with Tennessee Copper Corp., now metallurgist at Minerva Mine No. 1 mill, Cave-In-Rock, Ill.

Alfred R. Flinn, former resident engineer, has been appointed Eastern manager of mines by the New Jersey Zinc Co. with headquarters at New York. He will have general supervision of the company's mines east of the Mississippi. Mr. Flinn has been associated with the mining activities of the company for over 40 years.

A. L. Hayes has been named assistant to the vice president responsible for mining and exploration for New Jersey Zinc Co. Mr. Hayes, who joined the company in 1927 as an engineer at the Gilman, Colo., mine, has been assistant to the manager of mines since 1950.

Thomas Raymond Boteler, assistant personnel officer, U. S. Geological Survey, retired March 31 after more than 45 years of Government service.

Holger Petersen has been named manager of National Gypsum Co.'s new Burlington, N. J., gypsum plant. In 1952 he was promoted to manager of the Baltimore plant, a position which he held until his recent appointment. Succeeding Mr. Petersen as manager of the Baltimore plant is **Harold E. Beard,** who joined National Gypsum in 1947.

Leslie V. Whiton has opened an office in White Plains, N. Y., for consulting on matters pertaining to the production and marketing of non-ferrous metals. Since 1953, he has headed up the metal sales development program for Consolidated Mining & Smelting Co. of Canada until he moved to the U. S. at the end of 1955.

Walter R. Lowry, formerly treasurer and assistant secretary of the Beryllium Corp., has been named vice president and treasurer of the company. Mr. Lowry joined Beryllium as comptroller in 1952, and became treasurer and assistant secretary a year later, and was named to the board of directors last December.

Leon O. Gouin, formerly consultant geologist for Compania Exploradora de Bayamo, S. A., a subsidiary of United States Steel Corp. in Cuba, has joined H. A. Brassert & Co. as resident engineer in Mutun, Bolivia.

Nicholas Savage, for the past two years with Western-Knapp Engineering Co., has been named Northern Division manager for Southern Pacific Milling Co. In 1946, Mr. Savage was employed by the Oliver Iron Mining Co. of Minn., a division of U. S. Steel Corp., and then joined Pioneer Engineering Works.

Herbert Kay has been named manager of catalyst development for Climax Molybdenum Co. Previously he had been in charge of new chemical development.

John G. Barry has been appointed deputy director of the exploration division, Grand Junction, Colo., Operations Office of the U. S. Atomic Energy Commission. He served as staff engineer for nearly a year and also as acting chief of the Geologic Branch. **Philip H. Dodd,** geologist, has been named staff engineer, at Grand Junction. **Merle E. Crew,** who has been acting chief of the Engineering Services Branch for several months, was named chief of the branch. Mr. Barry, a graduate of the Massachusetts Institute of Technology, was president of Texas College of Mines and was once chief mining geologist for the American Smelting & Refining Co. in El Paso, Tex. He was chief of geological investigations for Metals Reserve, Board of Economic Warfare in Mexico City during World War II. Mr. Dodd joined the AEC at Grand Junction in 1948 as an exploration geologist. Mr. Crew was formerly with the U. S. Bureau of Mines at the Chamberlain, S. D., manganese pilot plant, and went to work for the Grand Junction offce in 1950 as a geologist.

CARROLL L. WILSON has been elected president of Metals & Controls Corp., manufacturer of electrical control devices and precious metals and nuclear fuel elements for atomic reactors. Mr. Wilson was first general manager of the Atomic Energy Commission, former president of Climax Uranium Co., and has been a member of the board of directors of Metals & Controls since 1951 and vice president and general manager of the corporation since June 1954.

John A. Johnson, district health and safety supervisor of the U. S. Bureau of Mines at Duluth, has been promoted to chief of the division of safety, in Washington, D. C.

J. M. Shields, formerly superintendent at the Biwabik mine which is now exhausted, has been transferred to the West Hill mine near Grand Rapids, of Pickands, Mather & Co., as assistant superintendent.

Thomas Olsen has been named assistant superintendent of the Arcturus mine of the Oliver Iron Mining Division at Marble, Minn.

Vernon Ahola has been named assistant superintendent of Oliver Iron Mining Division's Trout Lake concentration plant on the Mesabi Range.

Walter A. Sterling, president of Cleveland Cliffs Iron Co., has been named chief executive officer by the board of directors.

KENNEDY COMPLETE CRUSHING PLANT

for MIAMI RIVER QUARRIES, INC.

Now producing OVER 175 TONS per hour!

Designed and built by KVS to meet the specifications of the Miami River Quarries, Inc., Sidney, Ohio, this complete crushing plant produces in excess of 175 tons per hour of Limestone, crushed and screened to required gradation.

KVS Equipment, operating under exposed conditions with perfect satisfaction, includes 30 x 42 Primary Jaw Crusher, 38½ "S" Gyratory Crusher, Vibrating Screens, Pan Feeder, Belt Conveyors, with all required auxiliary equipment.

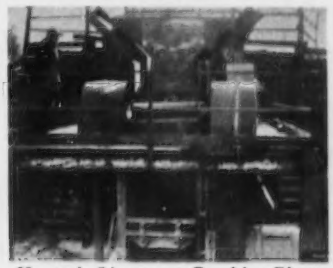
This typical Kennedy installation is like numberless other KVS jobs, designed and equipped to produce peak capacities at low operating and maintenance cost. Our engineering department will furnish operating data, specification, etc., on request.

Miami River Quarries, Inc., Sidney, Ohio — 175 Ton Per Hour Kennedy Limestone Crushing Plant.

Kennedy Limestone Crushing Plant Showing Conveyors.

Kennedy Limestone Crushing Plant Comprising 42" Pan Feeder and 30" x 42" Jaw Crusher.

Kennedy Limestone Crushing Plant Comprising 38½ "S" Gyratory Crusher, Type AAA Vibrating Screen and Belt Conveyor.



Kennedy Limestone Crushing Plant Comprising 30" x 42" Primary Jaw Crusher.

SEND FOR LITERATURE DESCRIBING KVS MACHINERY & EQUIPMENT.

KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK, N. Y. • FACTORY: DANVILLE, PA.

PERSONALS *(Continued)*

WILLIAM BELLANO has been named to the newly created post of director of mining and minerals exploration for International Minerals & Chemical Corp. Mr. Bellano was production manager for International's Phosphate Chemicals Division, where his principal responsibility was management of the company's new Bonnie phosphate chemicals plant. Prior to that, he was manager of general engineering services for the central engineering division, where he gained broad experience with the company's policies.

Norman J. Sather has left his position as mill superintendent for Hecla Mining Co. to accept an appointment as superintendent of concentration for the Bunker Hill Co. He will supervise metallurgy at the Star mill which he supervised for Hecla before that company sold its 50% interest to Bunker Hill.

Alvin W. Fahrenwald, University of Idaho dean of mines emeritus, has been awarded the Richards Award for 1956, presented annually by the American Institute of Mining & Metallurgical Engineers for achievement in the minerals beneficiation field.

W. L. Ziegler, former general manager of Pend Oreille Mines & Metals Co. at Metaline Falls, Wash., and authority on ore processing and mill design, has taken a position as consultant with Bunker Hill Co. He will continue his association with Pend Oreille Mines as a consultant and director. **L. M. Kinney** has been promoted to resident manager of Pend Oreille operations, and **Loren Billings** to superintendent. Other recent Bunker Hill appointments include the promotion of **Harold E. Lee** to manager of metallurgy, a post formerly held by general manager **Wallace G. Woolf,** and **LaVern Griffith** has been named manager of plant services.

Roy Peterson, mining engineer with Bethlehem Steel Co.'s coal mining division in Pennsylvania, is now with Pickands, Mather & Co. on the Gogebic Range, as project engineer.

Otto Brown, employee in the Iron River district, M. A. Hanna Co., was honored at his retirement after 36 years of service with Hanna. He was given a dinner and a memorial watch.

Joseph La Mere, master mechanic for Pickands, Mather & Co. at the Volunteer mine, has retired after 35 years with the company.

Dr. Grover C. Dillman, president of the Michigan College of Mining & Technology, will retire from his position on October 1, 1956. In public life for the past 41 years, Dr. Dillman became Michigan Tech's president in 1935. He joined the staff of the Michigan State College in 1913.

Therman B. Duckworth, former assistant blast furnace superintendent, Tennessee Products & Chemical Association, Rockwood, Tenn., has been appointed assistant superintendent, blast furnace department of Jones & Laughlin Steel Corp.'s Aliquippa Works, succeeding **A. T. Sadler,** Aliquippa, who earlier was named superintendent of the blast furnace department.

Michael J. Messel has been appointed general manager of Lake Asbestos of Quebec, Ltd., wholly-owned subsidiary of American Smelting & Refining Co. He will make his headquarters at Black Lake, Quebec. Mr. Mussell came to the U. S. in 1946 as general superintendent of the Ruberoid Co. and became manager of its Vermont Asbestos Mines Division, the position he held before being named general manager of Lake Asbestos of Quebec, Ltd.

Señor Mauricio Hochschild was given a luncheon at the Carrera Hotel by the principal members of the staff of his South American companies to celebrate his 75th birthday. Mr. Hochschild first came to Chile in 1911 and has been closely connected with many successful mining ventures in Chile, Bolivia and Peru since that date.

Jack Milliken of Grand Forks, B. C., Canada, has been named chief engineer for Mid-West Copper Co.'s Velvet Mine. He was a district engineer for the B. C. Government's Department of Highways.

Dr. S. E. Maddigan, former director of British Columbia Research Council, has been appointed special assistant to Kaiser Aluminum Co.'s director of metallurgical research at Oakland, Calif.

C. A. Lehnertz Jr., former resident geologist for Colorado Exploration Co., Lander, Wyo. for the past two years, has joined the staff of Doeringsfeld, Amuedo and Ivey, specialists in photogeologic evaluations, in Denver.

Teodoro Kohler D., former mill superintendent of Cia. Minera de Tocopilla, in Chile, has joined the staff of Cia. de Minas del Peru and is now in charge of the Esquilache lead-zinc mill, near Puno, Titicaca Lake.

Aubrey Fletcher has been named assistant vice president of C. Tennant, Sons & Co. Since joining the company in 1946, Mr. Fletcher has been associated with establishment of two subsidiary companies in South America.

O. A. Glaeser has been elected a director of United States Smelting Refining & Mining Co. to fill a vacancy resulting from the resignation of **W. C. Page;** and **J. V. Neuman Jr.** was elected vice president and general manager of oil operations.

Lynn Keith is now associated with a uranium and exploration operation in Los Angeles County, Calif.

Wade Taylor has been appointed regional director of the Bureau of Reclamation's Region 3, at Boulder City, Nev. He has been acting regional director since the death of J. P. Jones.

Jules A. Coelos, with Oliver Iron Mining Division, has been transferred to Pittsburgh as assistant director of raw materials for U. S. Steel Corp.

J. K. Young, chief electrical engineer for Cleveland Cliffs Iron Co., has retired after 48 years with the company.

N. P. Arnold, mechanical engineer who has been superintendent of maintenance on the Mesabi Range for Cleveland Cliffs Iron Co., has accepted a position as plant superintendent for W. S. Moore Co., at Duluth.

Clifford Niemi, general plant foreman, has been promoted to assistant superintendent of Oliver Iron Mining Division's Extaca taconite plant at Mt. Iron.

Dr. Richard A. Dodd, British metallurgist, has been named to the faculty of the School of Metallurgical Engineering, University of Pennsylvania. Dr. Dodd, former research metallurgist in the Canadian Department of Mines since 1954, will become assistant professor of metallurgical engineering.

F. Peter Robbins has been named special assistant, Mining Division of Manu-Mine Research & Development Co. Before the war Mr. Robbins was engaged in exploration and development of hard-rock and placer gold in Alaska and in mechanization of underground zinc production in New Mexico.

John Sheppard has been named district manager, and **W. F. Richards** has been named assistant district manager of the Hibbing, Minn., office of Western Knapp.

A. W. Storm has been named supervising engineer for Erie Mining Co., succeeding **B. W. Bernstrom,** who has been promoted to chief mechanical-electrical engineer for Pickands, Mather & Co.

A NEW ERA IN UNDERGROUND MECHANIZATION

with the

EIMCO Crawler Model 630 Series

The Eimco 630 series has been developed, at the request of operators, to take numerous types of auxiliary equipment.

The basic tractor unit, with the excavator attachment, has been adequately field tested. No tractor unit is ever subjected to rigorous field testing until it has an overhead loader of the Eimco type mounted upon its frame. No tractor unit manufacturer can boast the complete stability of his equipment until this test has been satisfactorily completed.

Eimco 630 tractors with excavator attachments have proved their efficiency and dependability in operation in many countries, under the most difficult conditions. Some operators have taken out track to convert to trackless operation. One customer has 16 machines installed or on order. Some contractors have completely changed over to 630's for their loading operation. One mining man says "it's the greatest thing in mining equipment since the rotating drill."

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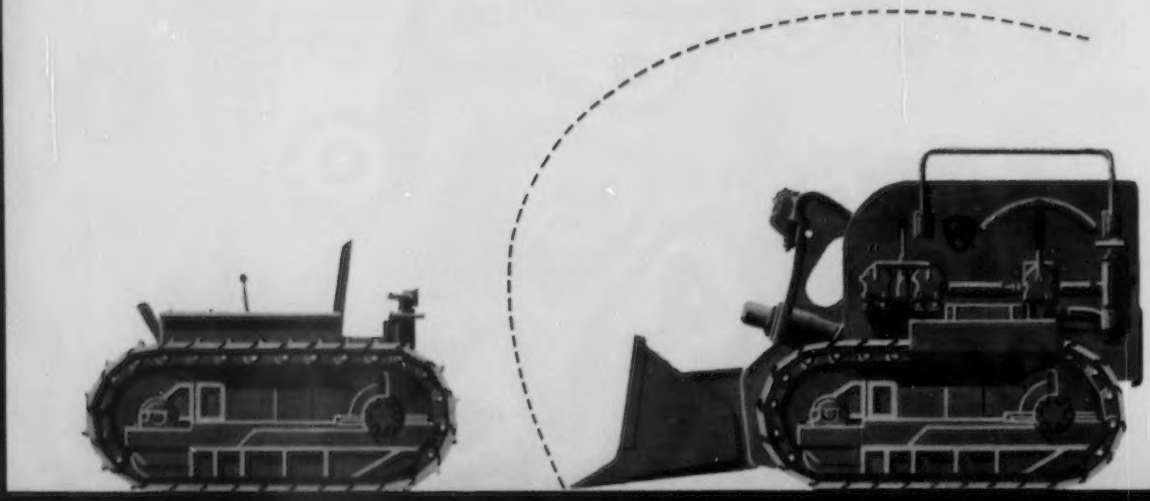
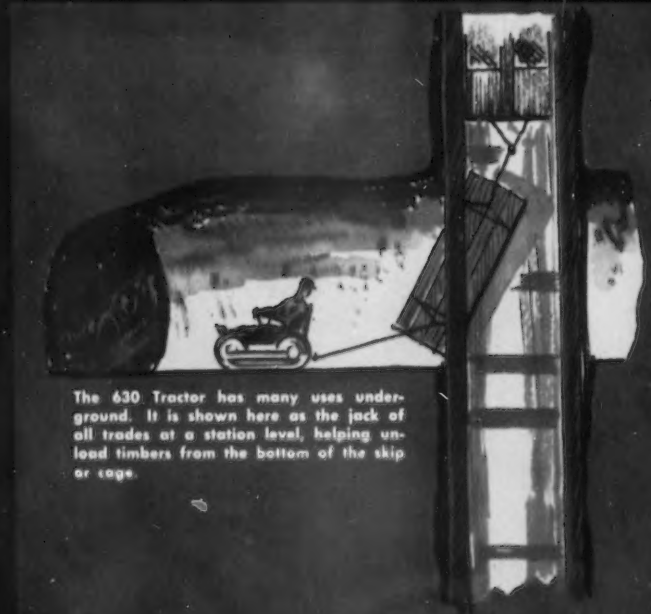
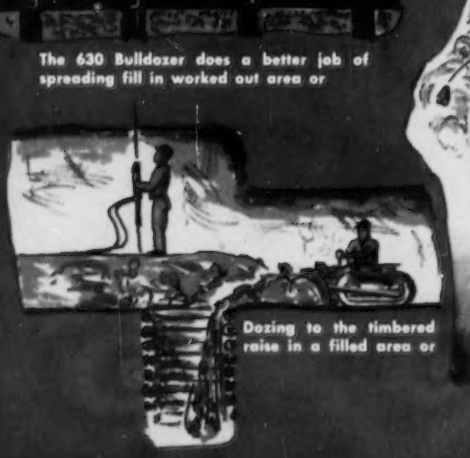


EIMCO 630 S



The 630 Tractor has many uses underground. It is shown here as the jack of all trades at a station level, helping unload timbers from the bottom of the skip or cage.

The 630 Bulldozer does a better job of spreading fill in worked out area or



Dozing to the timbered raise in a filled area or

ditionally weak on ordinary crawler equipment. Such items as track frames, idlers, rollers, sprockets and track chains have been given special attention in design and production.

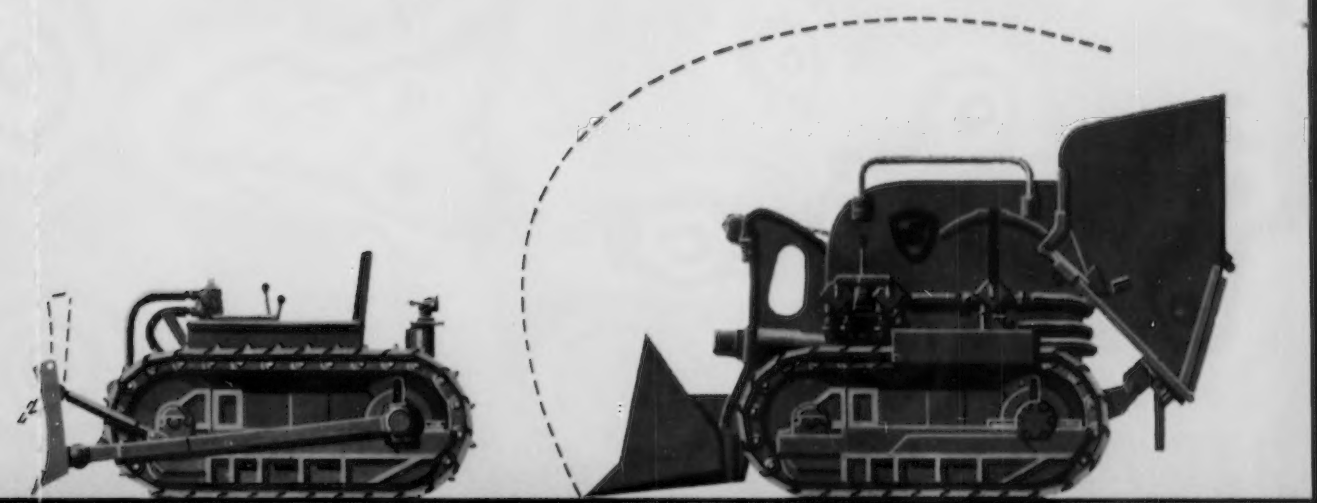
Special heat treatment is another exclusive feature of Eimco 630 parts. Each part is given the type of heat treatment most suited to producing the end result of long life in continuous operation.

All of these factors result in a machine that will work longer and harder with lower maintenance costs and a minimum of attention. Here are some of the jobs the 630 can do for you.

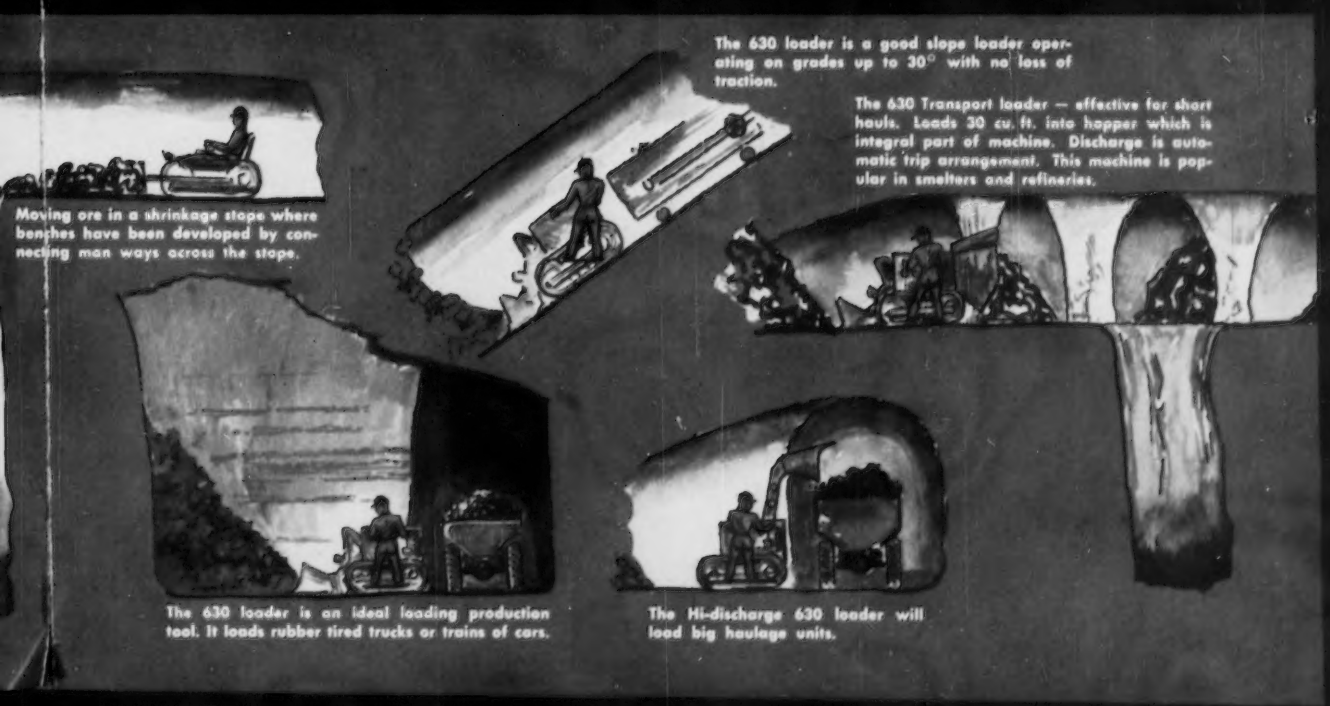
The 630 as an excavator will dig in and load rock, sand, gravel, conglomerate, clay or other material at an unprecedented rate. It is built in several discharge heights (see specs) to provide for low head room or high head room and under any conditions to load the car or truck full. The excavator is an ideal unit for development, drawpoint loading and production from room systems.

For extremely low head room, specify the 635 loader which meets the overall head room requirements that are under five feet. This model incorporates many new features in loading equipment and is covered by patents and patents pending as are the other 630 models. The advantages of the 635 are in fast loading and the ability to store the biggest part of a car load on its conveyor. It also provides for complete loading of long low cars in restricted head room areas.

In areas where a short haul is required, it is many times desirable to use the 630 tractor-hopper



SERIES FOR LOW



Moving ore in a shrinkage stope where benches have been developed by connecting man ways across the stope.

The 630 loader is a good slope loader operating on grades up to 30° with no loss of traction.

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630 Tractor

630 Tractor-Excavator

630 Bulldozer

WHAT IS THIS NEW ERA?

This is the era of high productivity — of mining low grade ore at a profit through the use of new mining tools and equipment.

Eimco's contribution to this new era is its new crawler Model 630 Series machine. This is not an experiment, but a thoroughly field tested unit that is meeting with outstanding success and acceptance. It gives the miner the equipment he needs to drill more holes, to bar down quickly and in safety, to load out more rock faster, even in low headroom, to back fill, to bulldoze, to set timbers, to dig, to carry, to mine pockets, to bolt roofs, to sink shafts and a thousand other jobs — and to do all these things more easily than ever before.

This new productivity is within the reach of every mining operation. Eimco offers, in its Model 630 machines, to the company crew, the contractor or the prospector a new, efficient and effective means to combat costs and increase production.

The 630 is a heavy-duty air or electric powered tractor or prime mover. It is the chassis on which we have designed and built a host of dependable, highly useful machines and attachments, some of which are shown in the next pages. As on all of Eimco's equipment, the castings are heavy alloy steel, the construction is heavy-duty throughout. The tracks on the 630 are independently controlled. There are no clutches, no foot levers, no gear shifts — just two simple handles to move forward or reverse for a similar motion in the machine. Twist the handles for a spin turn moving one track forward and the other reverse at the same time.

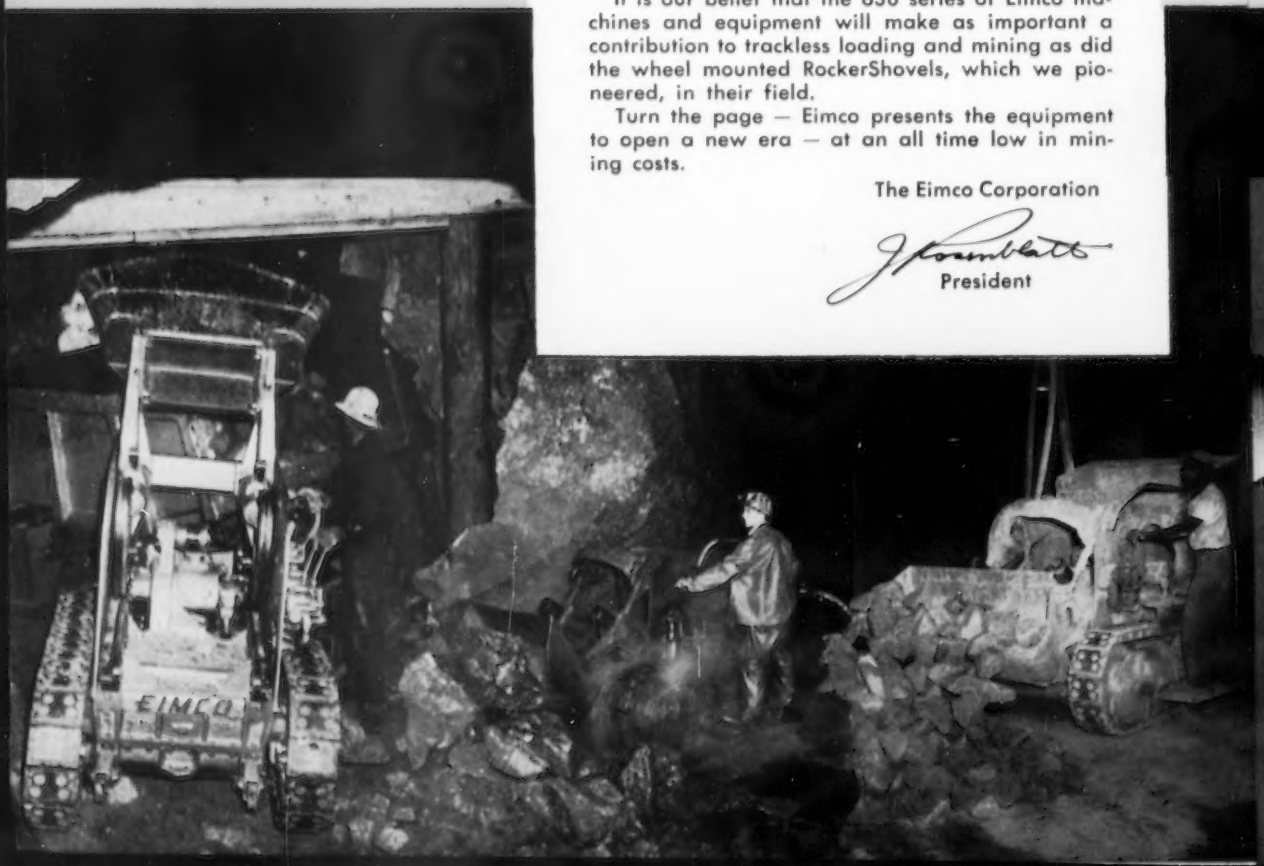
It is our belief that the 630 series of Eimco machines and equipment will make as important a contribution to trackless loading and mining as did the wheel mounted RockerShovels, which we pioneered, in their field.

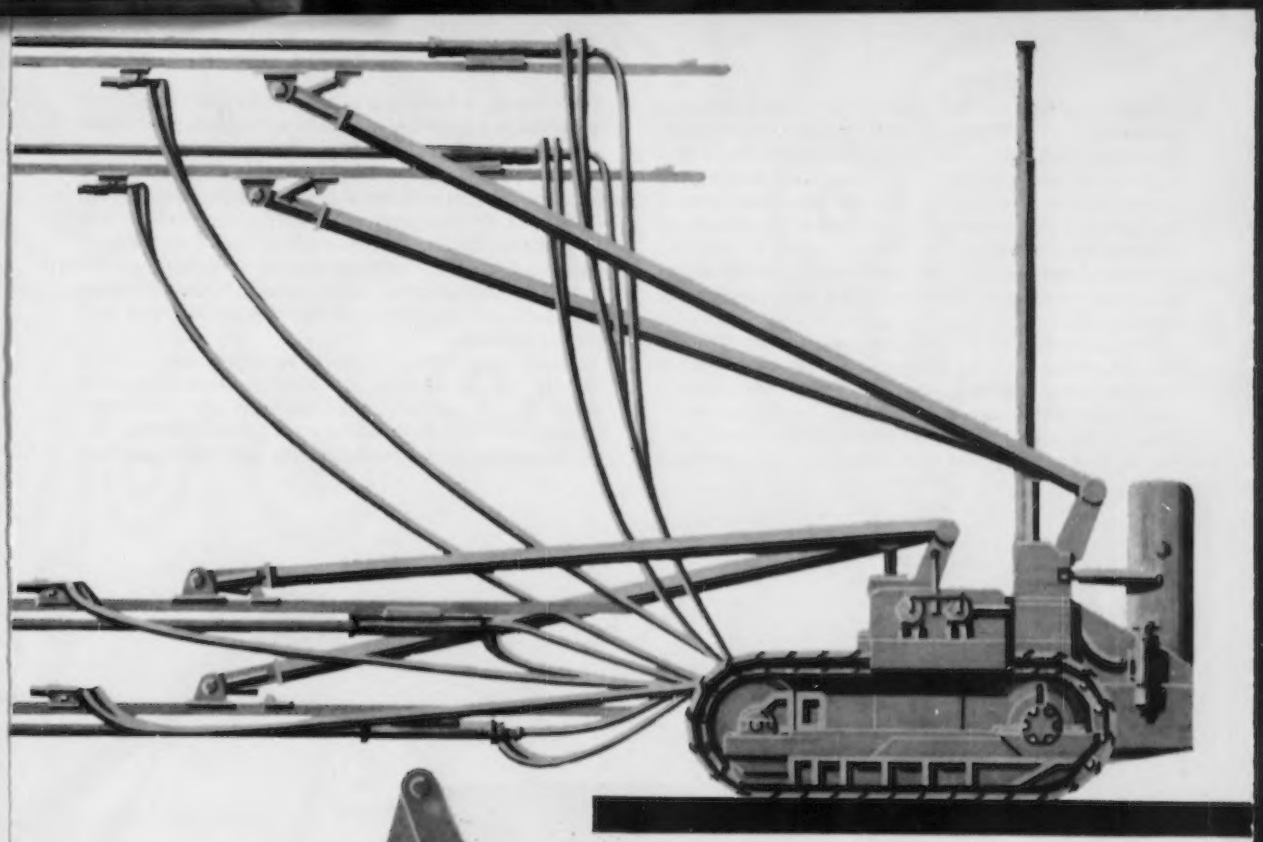
Turn the page — Eimco presents the equipment to open a new era — at an all time low in mining costs.

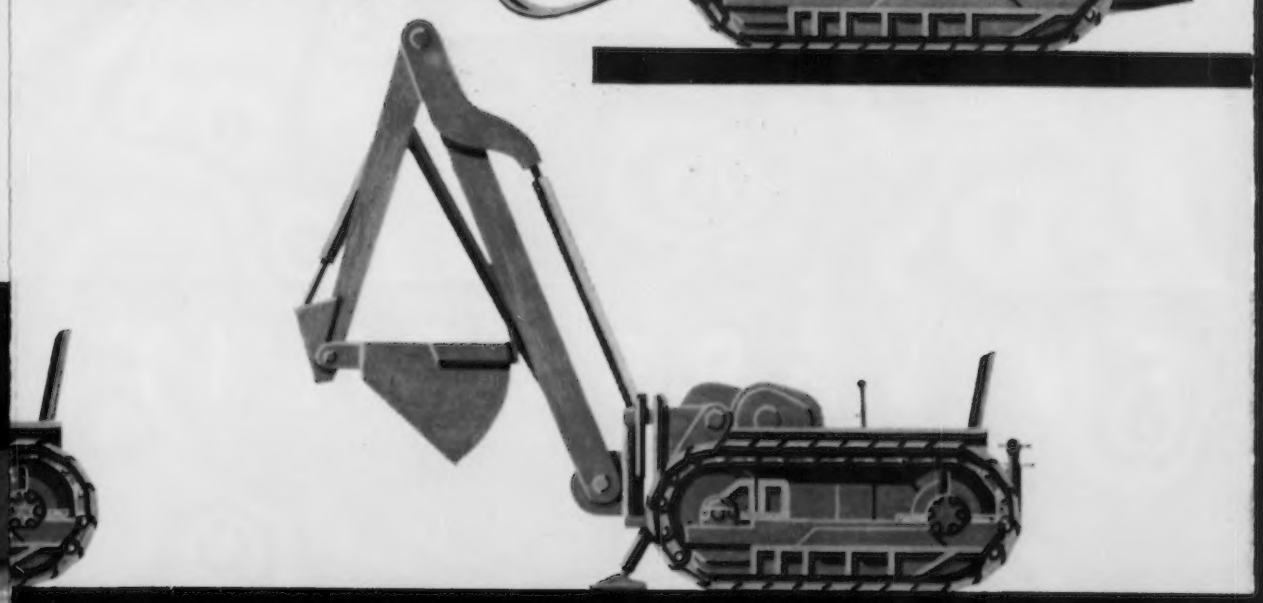
The Eimco Corporation

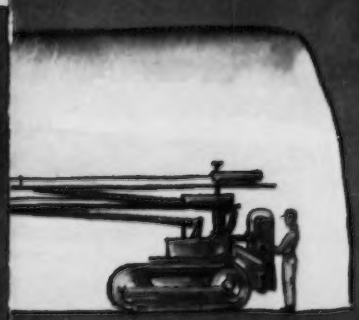
J. Lamblatt

President









perators controls are located at the rear. olds into a compact unit for moving.

The 630 ditch digger or backhoe has many uses on the surface as well as underground.

The 630 Two machine jumbo. This is an easy operating unit. It can be maneuvered to drill the complete face and move out of the way for the loading equipment.

The Eimco 630 series has been developed, at the request of operators, to take numerous types of auxiliary equipment.

The basic tractor unit, with the excavator attachment, has been adequately field tested. No tractor unit is ever subjected to rigorous field testing until it has an overhead loader of the Eimco type mounted upon its frame. No tractor unit manufacturer can boast the complete stability of his equipment until this test has been satisfactorily completed.

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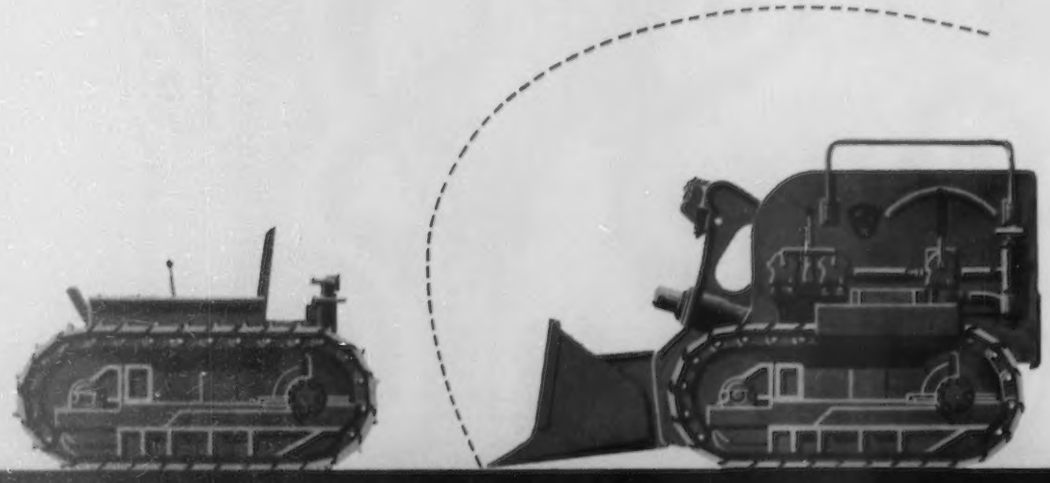
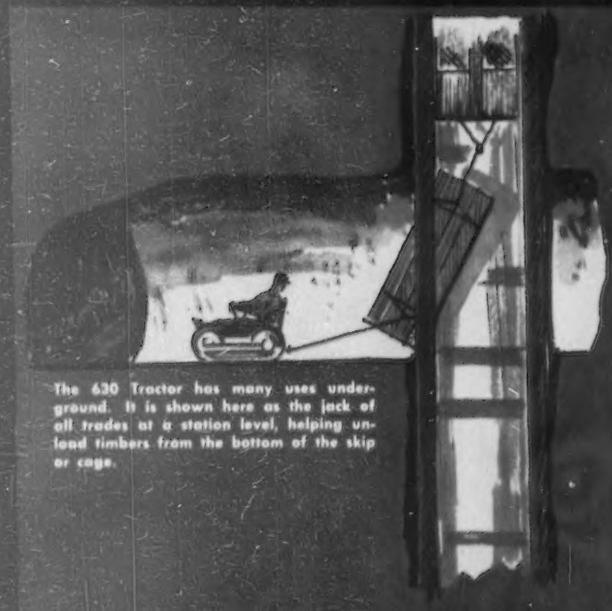


EIMCO 630 SERIES F



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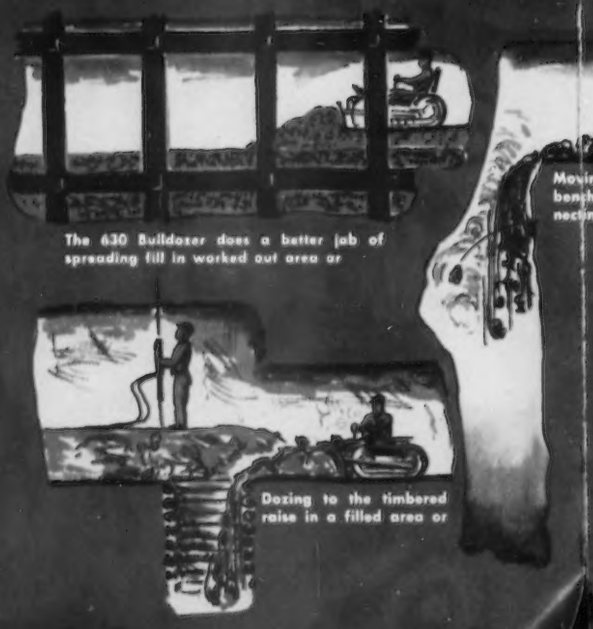

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In areas where a short haul is required, it is many times desirable to use the 630 tractor-hopper — which is an excavator unit with an integral hopper. This unit has been popular not only in mines but in smelters, chemical and pigment plants and many others where bulk material is to be moved to a hopper at floor level. The hopper on the 630 tractor-hopper can be easily adjusted to open and close automatically.

The 630 bulldozer has found an application in stopes where a drift has been cut in the ore and then widened by slicing on the wall to provide an open level for drilling vertical holes to drop the ore into drawpoints at the bottom of the stope. It has also been used for spreading fill waste in stopes and for dozing ore into the cribbed ore chute that comes up through the waste fill. Numerous other uses have been suggested for this versatile bulldozer.

The 630 tractor as a bare unit h
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One important use for the 630 tr
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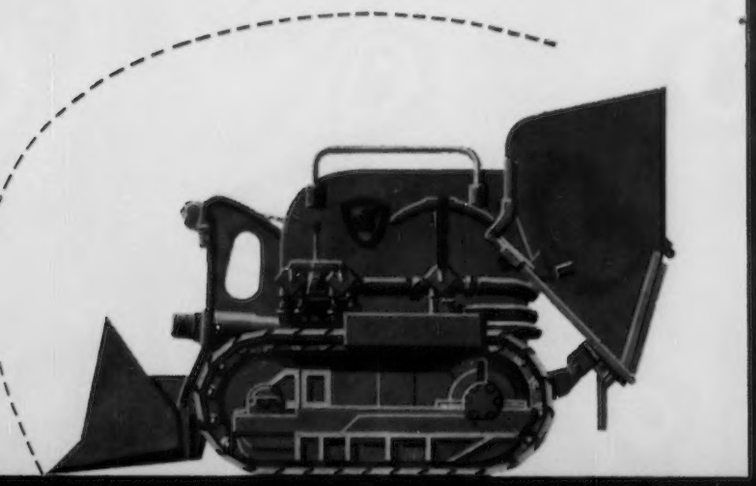

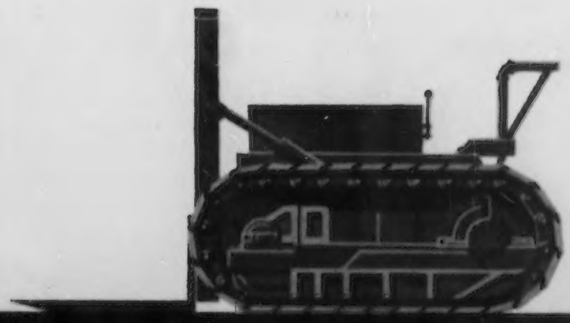

FOR LOW COST MINING

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The Hi-discharge 630 loader will load big haulage units.

The 630 fork lift has many uses underground and on the surface. Loading and unloading trains. Carrying supplies and equipment are among its many uses.

The fork lift equipped with a platform provides a substantial and easily mobile scaling platform.

The front end 630 loader is
and its excellent maneuverabili
inside the confined area of a

Where a slice has been made and cars cannot conveniently be brought into the room.

ich is an excavator unit with an integral hop- This unit has been popular not only in mines smelters, chemical and pigment plants and others where bulk material is to be moved opper at floor level. The hopper on the 630 r-hopper can be easily adjusted to open and automatically.

630 bulldozer has found an application in where a drift has been cut in the ore and widened by slicing on the wall to provide an level for drilling vertical holes to drop the ore drawpoints at the bottom of the stope. It has een used for spreading fill waste in stopes and zing ore into the cribbed ore chute that comes rough the waste fill. Numerous other uses been suggested for this versatile bulldozer.

The 630 tractor as a bare unit has been found better than previous methods for pulling timbers, rails and miscellaneous supplies into the station from the shaft opening. Operators claim better control and less lost time using the 630 tractor.

One important use for the 630 tractor-excavator is in shaft sinking. One operator in Virginia and one in Wyoming have used a new shaft sinking technique to employ the 630 and have reported outstanding success. These contractors use less men in the bottom and practically no set up time. Both have been impressed with the idea that when the shaft is complete they have a unit that can be used in development or production in regular mine operation and do not have the expense of single purpose shaft mucking equipment.

For operators who prefer front end loading equipment, the 630 front end loader is available. This type of loader can be used in restricted head room and has its application in narrow headings or rooms where loading is into haulage equipment in front of the machine or for cleanup on muck pushed to a location by the bulldozer. The 630 front end loader can be used as a combination dozer and loader and has a place in spreading or placing fill.

The 630 tractor is well adapted to the drilling portion of the cycle as a base for the jumbo. When a single machine is mounted with a short feed it can be employed as a "crust breaker." This operation is typical around pots in the aluminum industry or in breaking out consolidated slag in rever-

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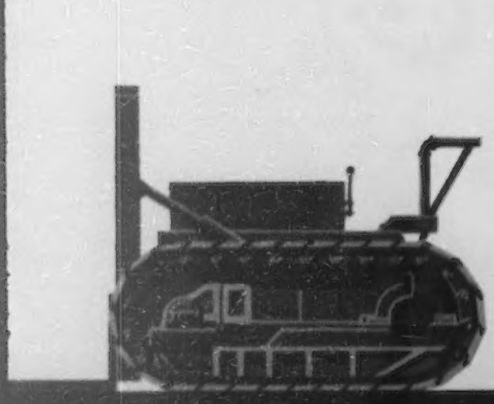
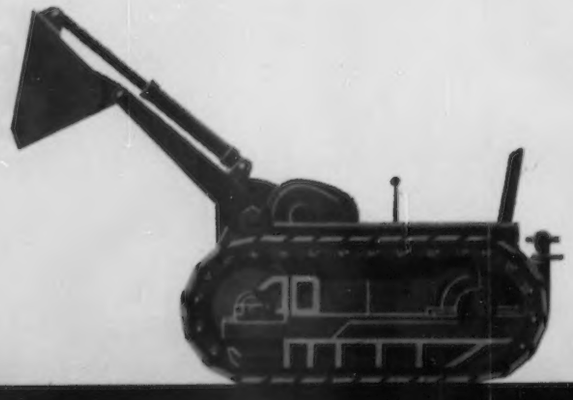
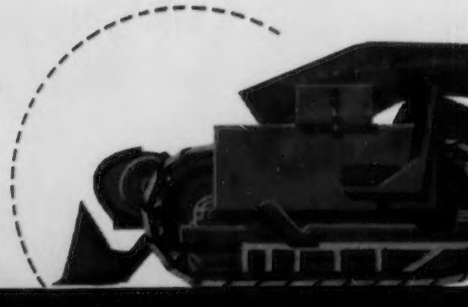






OST MINING WITH VERSA

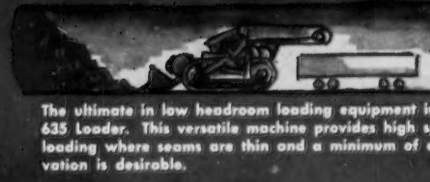
fork lift has many uses underground and on the Loading and unloading trains. Carrying supplies uipment are among its many uses.

The fork lift equipped with a platform provides a substantial and easily mobile scaling platform.

The front end 630 loader is desirable for low headroom operations and its excellent maneuverability enables peak capacity loading, even inside the confined area of a gondola or

Where room is limited and muck has been dropped from a raise close to the haulage way or

Where a slice has been made and cars cannot conveniently be brought into the room.



The ultimate in low headroom loading equipment i 635 Loader. This versatile machine provides high loading where seams are thin and a minimum of vation is desirable.

The 635 Eimco Loader is ideal for long low cars and the "shuttle-buggy" type of haulage equipment.

beratory type furnaces. This same type of unit has an ideal application in "scaling." Here the operator can control the drill direction accurately and break down loose material from any location in the heading because of the maneuverability of the 630.

Forklift attachments are used in the stations underground for removing and piling timbers and lagging from the train at desired locations, carrying to the headings or raise areas. These units can also be used as platforms for driving lagging between the sets.

The timber setter is used for lifting and setting the heavy timber cap in heavy ground. This unit saves time in getting the timber in place and reduces time lost in production or development.

For mines using "roof-bolting" instead of timber, the 630 tractor provides an excellent mounting for roof bolting apparatus. The easy operation and extreme mobility of the 630 makes it ideal for this type of work.

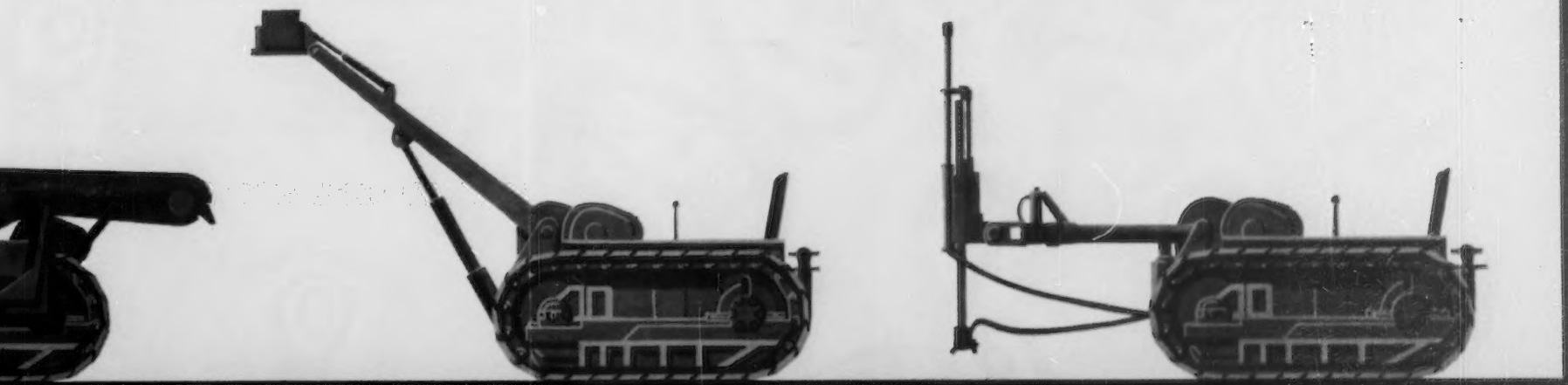
Where comparatively low head room requires the mobility of low equipment, the 630 tractor can be equipped with drill mountings and used as a jumbo.

Two drill jumbos for the average heading, positioned, raised, lowered or moved at any angle give new freedom to the miner and speed up the drilling program.

High speed tunnels and production jobs can use the long base 630 tractor for mounting as many as four drill rigs with its separate controls for all movements and operated from the rear of the tractor. The four machine unit will drill out a round quickly and provide for maximum number of rounds per shift.

For drainage ditches, sumps, and other excavation below grade and in confined spaces, the 630 can be equipped with a back hoe with 180° swing for loading into cars or rubber tired haulage equipment.

The 630 tractor-excavator combination is excellent for loading on slopes. Grades to 30% require no cables or other anchoring devices to operate efficiently. It is suggested, however, that if the 630 tractor-excavator is being considered for slope operation that such information be given to the Eimco engineer so that the step plate can be modified for the proper angle and the bucket be adjusted to the proper discharge angle.



SATILITY UNDERGROUND

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The 630 timber setter is another version of this versatile Eimco air powered tractor. With independent track control, the 630 provides the only mobile unit that will place timber without numerous movements to "line-up."

The 630 roofbolter. Another unit unsurpassed in speedy operation because of the maneuverability of the Eimco tractor unit. Holes can be located quickly and efficiently.

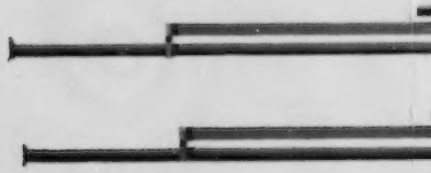
The 630 "crust-buster" designed to break out scale or take up bottom in a reverberatory type furnace.

Another adaptation of the "crust-buster" is the 630 "scaler." This gives the miner an opportunity to scale the entire face quickly and efficiently, while sitting down in a safe position.

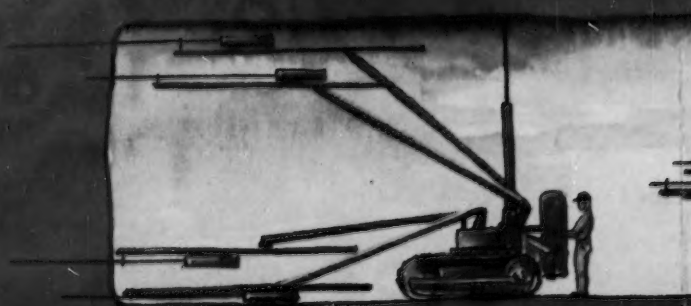
The 630 Eimco loader as a shaft mucker. This machine has been used successfully in several shafts and works effectively in either round or rectangular shafts. The 630 loads faster, requires no special set-up, uses less men than specialized equipment and provides a standard type drifting machine when drifting starts at the desired level.

The various attachments shown on these pages are manufactured by numerous specialized equipment builders and no particular brand is intended to be reproduced in these sketches.

Any equipment suitable for mounting on the Eimco 630 tractor base can be shipped directly to the job. Manufacturers of the various attachments can provide adaptor plates or secure standard drilling patterns from Eimco so that their attachment will be easily mounted.

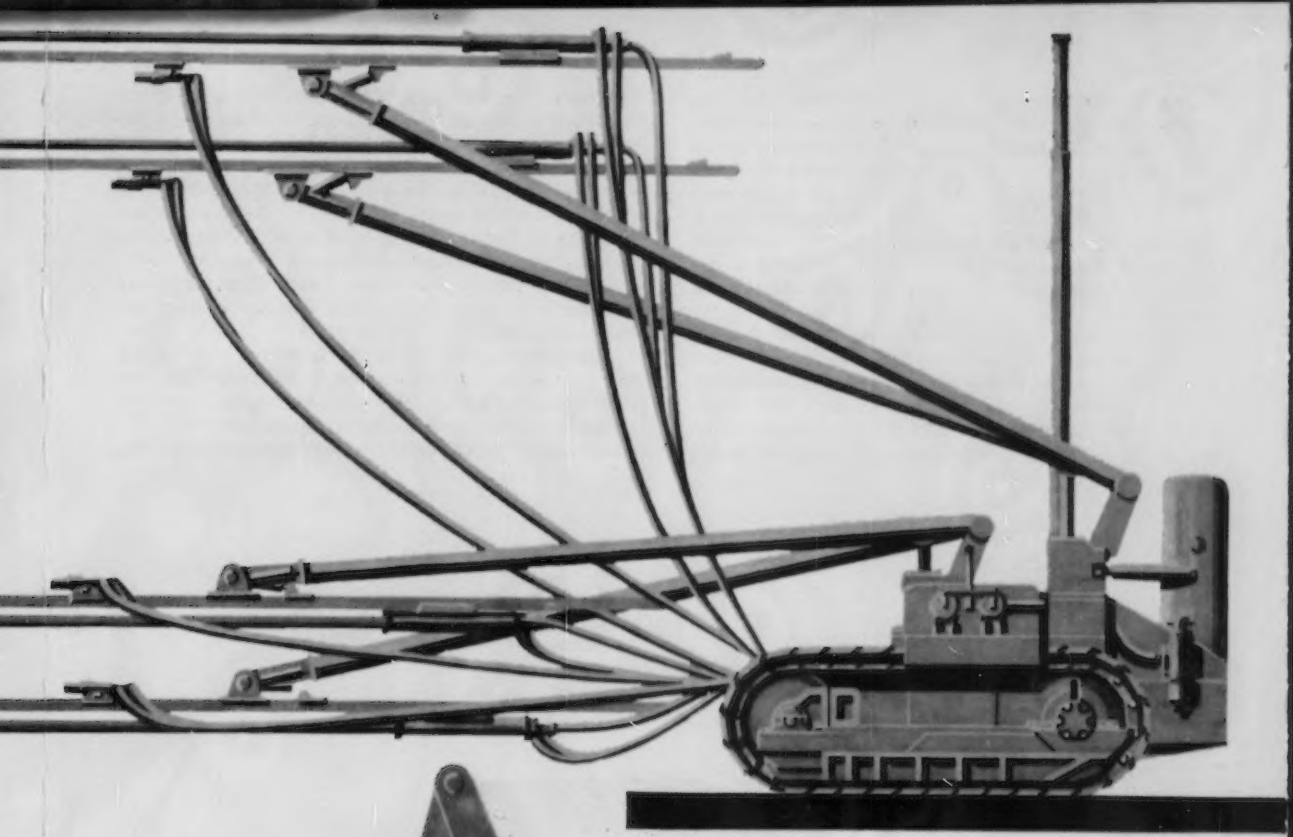


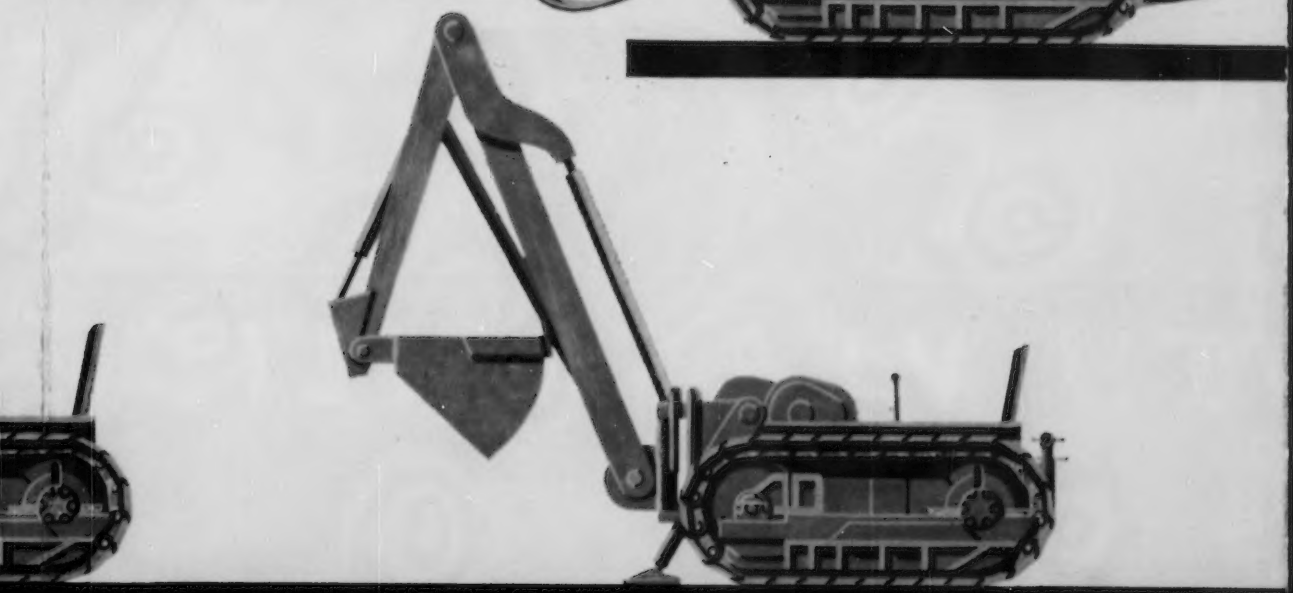
The 630 tractor drill replaces the old style wagon drill. The operator spots the hole, drills the hole and drives the rig from the sitting position. He can drill more holes per shift with less effort.



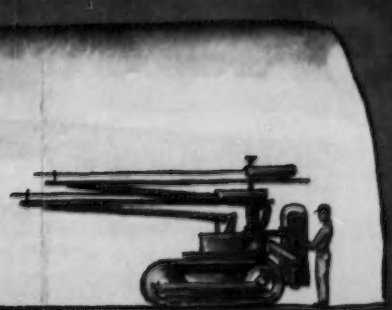
The 630-four machine jumbo. This unit uses the long base Eimco tractor and because of the numerous controls used in raising, lowering, moving and drilling with each boom, the o
The jumbo t

EIMCO 630 SPECIFICATIONS





The 630 ditch digger or back-hoe has many uses on the surface as well as underground.



the operators controls are located at the rear. mbo folds into a compact unit for moving.

The 630 Two machine jumbo. This is an easy operating unit. It can be maneuvered to drill the complete face and move out of the way for the loading equipment.

EIMCO 630 SPECIFICATIONS

630 TRACTOR

	ENGLISH	METRIC
Overall Height	45"	1145mm
Track Height	28"	710mm
Grouser Height	1 1/16"	30mm
Overall Width	55"	1395mm
Track Shoe Width (standard)	9"	230mm
Track Gauge	45"	1145mm
Ground Clearance	6"	150mm
Oscillation at Front Idler	6"	150mm
Overall Length	71⅞"	1825mm
Length of Track on Ground	43⅞"	1115mm
Height of Drawbar Above Ground	9⅝"	245mm
Drawbar Tongue Opening	2"	50mm
Drawbar Pin (diameter)	1½"	40mm
Air Inlet — Pipe Size	2" IPS	
Weight Complete	6500 lbs.	2950 kg.
Area of Ground Contact (9" trackshoe)	790 sq. in.	5100 sq. cm.
Speed	0-1.5 MPH	0-2.4 km./hr.
Motors (Eimco Air or A.C. Electric)	3	3
Electric Motor Rating	SPECIAL	
Air Motor Rating	12 HP @ 90 psi	
Drawbar Pull (lbs.) at Zero Track Slippage	10600 lbs.	4800 kg.

630 LONG FRAME TRACTOR

Overall Length	88"	2235mm

630 TRACTOR-DOZER

Overall Length	91 1/16"	2320mm
Blade Pitch Angle Adjustment	10°	10°
Maximum Blade Lift	16"	405mm
Maximum Blade Dig	7"	180mm
Maximum Blade Tilt	8"	205mm
Blade Height	26¾"	680mm
Blade and Overall Width (Longer Blades Available)	62"	1575mm
Weight Complete	7980 lbs.	3620 kg.

630 TRACTOR-EXCAVATOR

Overall Operating Width	5'8⅛"	1745mm
Minimum Height	4'11½"	1510mm
Overall Length (bucket down, std. bucket)	9'4"	2845mm
Minimum Length	6'3⅛"	1910mm
Maximum Digging Depth Below Grade	22"	560mm
Head Room	6'8"-10'7"	2030-3225mm
Discharge Height	3'9"- 7'2"	1145-2185mm
Bucket Capacity	5½-11¼ cu. ft.	⅙-½ cu. meters
Weight Complete	9400 lbs.	4260 kg.

630 TRACTOR-HOPPER

Width of Hopper	4'6½"	1385mm
Overall Length (bucket down)	10'6"	3200mm
Length of Tractor (with hopper)	8'0"	2440mm
Hopper Capacity	32 cu. ft.	0.9 cu meters
Weight Complete	12000 lbs.	5445 kg.

635 TRACTOR-LOADER

Overall Length (bucket down)	10'9"	3275mm
Minimum Headroom	5'0"	1525mm
Bucket Capacity	5 cu. ft.	¼ cu. meter
Belt and Hopper Capacity	15 cu. ft.	½ cu. meter
Weight Complete	11000 lbs.	4990 kg.

The Eimco 630 Tractor is an air or electric powered prime mover that can be fitted with a special excavating attachment and other tools.

This rugged, dependable machine is the answer to the needs of miners and contractors alike. The maximum of trouble-free operation and long-life has been built into each and every part of the Eimco 630 Tractor.

Many new features and advantages in tractor design have been incorporated in the 630. Independent track control provides a pivoted turn by running one track forward and the other track reverse. This feature makes it possible to maneuver from any angle without backing to make a new approach. All wearing parts are easily replaceable in the Eimco design. All parts are easily accessible for quick, easy maintenance work. Tracks oscillate for operation on uneven ground. Tracks are equipped with spring release to clear rocks or obstructions in the tracks. Front idlers are solid web type, one piece cast steel. Track links are heat-treated alloy-steel forgings. Track pads are heat-treated alloy-steel castings, with integral cast grousers if required. Rigid cast steel diagonal brace construction provides track alignment that stays true. Heavy shafts and oversized anti-friction bearings are used throughout.

Controls are simple. Two handles, conveniently located in front of the operator, effect all tractor movement.

Mounting pads are provided with suitable tapped holes for mounting many types of tractor attachments.

All parts are carefully heat-treated for maximum service and minimum wear. All parts are of heavy alloy-steel cast or fabricated construction for typical Eimco long-life and trouble-free heavy duty operation.

Write or call the nearest Eimco Office for more information on the modern Eimco 630 Tractor.

THE EIMCO CORPORATION

EXECUTIVE OFFICES AND FACTORIES: SALT LAKE CITY 10, UTAH
EXPORT OFFICES: EIMCO BLDG., 52 SOUTH ST., NEW YORK CITY

BRANCH SALES AND SERVICE OFFICES: New York, N. Y., 51-52 South St. — Birmingham, Ala., 3140 Fayette Ave. — El Paso, Texas, Mills Bldg. — Chicago, Ill., 301 So. Hicks Rd., Palatine — Duluth, Minn, 216 E. Superior St. — Kellogg, Idaho, 307 Division St. — San Francisco, Calif., 637 Cedar St., Berkeley — London W.1, England, 190 Piccadilly — Houston, Texas, 4008 Purdue St. — Pasadena, Calif., 434 No. Lake Ave. — Baltimore, Md., P. O. Box 1052 — Pittsburgh, Pa., Investment Bldg. — Seattle, Wash., 208 Hoge Bldg.

AFFILIATED EIMCO COMPANIES: Societe Eimco, 29 Rue De Mogador, Paris 9, France — Eimco (Great Britain) Ltd., Gateshead-on-Tyne 11, Co. Durham, England — Eimco Italia, S.P.A., Via Senato 11, Milan, Italy — Eimco (South Africa) Pty. Ltd., 136 Kindon Road, Robertsham, Johannesburg, South Africa — Eimco Canada Limited, 320 Industrial Ave., Vancouver 4, B. C., Canada.

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PERSONALS *(Continued)*

Sheldon J. Dicks, mining engineer with Pickands, Mather & Co., is now with the raw material department of Youngstown Sheet & Tube Co.

George H. Cobb, assistant to the president of Kerr-McGee Oil Industries, Inc., has been assigned duties and responsibilities of uranium exploration formerly performed by **J. C. Finley,** vice president in charge of exploration.

Yucca Uranium, Inc., has elected the following officers;; **Melvin E. Richards,** president; **William S. Horamin,** secretary-treasurer; **Lindsey J. Green,** vice president. Newly elected directors of the corporation are: **G. R. Kennedy** and **A. Ray Barker.**

OBITUARIES

David M. Wright, Sr. 68, general manager of the Swift & Co. phosphate mine at Bartow, Fla., from 1940 until his retirement in 1952, died March 11 in Emory University Hospital following an emergency operation. He was general superintendent of the mine from 1926 until 1940.

RONALD CLIFFORD ROWE, 66, mining engineer and editor of the "Canadian Mining Journal", died March 27. Born in Norfolk, England, Mr. Rowe came to Canada in 1910 and joined the Bell Graphite Co. Prominently identified with the graphite mining and refining industry for some years, he managed the Consolidated Graphite Co. and the Crucible Graphite Co., and designed and installed the first graphite flotation plant in Canada in 1919. He joined the staff of "Canadian Mining Journal" in 1927.

Compton I. White, 76, former U. S. Representative and strong supporter of silver currency during 16 years in Congress, died March 31 in Spokane, Wash., following an illness of 2½ months. Mr. White owned the Whitedelf and Clarinda mining companies in northern Idaho. During his terms in Congress representing Idaho, he submitted a number of resolutions calling for international agreement on basing currency standards both on silver and gold.

Carroll P. Charlton, 70, associated with British Columbia mining ventures for 50 years, died February 11. Prior to his retirement in 1946, he was secretary-treasurer of Britannia Mining & Smelting Co.

Ed A. Ellis, 71, owner of extensive mica mining properties in the Spruce Pine, N. C., area, died March 13.

Manganese Ore Flotation

(Continued from p 99)

applied for less than 48% Mn, for more than 6% Fe, for more than 11% combined SiO_2 and alumina, and for more than 0.12% P. Likewise, a bonus is applied for ore containing more than 48% Mn and for ore containing less than 6% Fe.—Ed.]

Flotation recovery of manganese varies from 70 to 90%, depending upon the iron and manganese contents of the ore. Notice the table above. Test No. 1 used ore from Sherman Valley. So did test No. 3. Test No. 2 was on ore from White Rocks area. Comparison between tests 1 and 2 revealed that an increase in iron content is more detrimental to successful flotation than is a decrease in manganese content. Test No. 4 indicated that the lowest grade ores, being poor in manganese and rich in iron, can be concentrated by tabling and flotation for use in making spiegeleisen. Ore used in this test came from Sherman Valley and contained 3.58% Mn, 22.6% Fe and 57.1% insoluble. It was upgraded at minus 100 mesh on a Wilfley table at 71.3% Mn recovery, ground to minus 150 mesh for flotation.

Difficulties in flotation of the high-iron manganese ores are: that high concentration of depressants and high pH value, ranging from 8.3 to 9.0, employed for depressing goethite and limonite in large quantities are somewhat detrimental to the flotation of cryptomelane; and the activation of limonite in the pulp increased directly with the iron content of the ore. In addition, manganese ore of high iron content usually has high phosphorus as well, because the phosphorus-bearing mineral is closely associated with the goethite and limonite.

Any attempt to lower the iron content by tabling and magnetic separation ahead of flotation proved unsuccessful. This was chiefly caused by the fact that goethite and cryptomelane have similar specific gravities and both are weakly magnetic. Specific gravity of cryptomelane was 4.28.

In addition to the tests shown here, fatty-acid flotation concentrate was further treated with an amine in an attempt to remove the insoluble. Results were not good. There appears to be no clear separation between the silica and silicates, and the manganese.

Upgrading of dried flotation concentrate with a laboratory Frantz magnetic separator indicated that it was possible to raise concentrate grade by 0.5% Mn and to lower insoluble by 1% and Fe by 0.2%. Conditions were: 0.15 amperes, 20 deg longitudinal slope and 2 deg backward transverse slope. This improvement in grade was made at a sacrifice of 4% Mn: it does not appear that this is an effective method. Flotation, based upon the results shown in the table, appears to be the most satisfactory method for low-grade manganese.

Manganese minerals in these tested ores are chiefly cryptomelane, possibly KMn_8O_{16}, with minor amounts of pyrolusite and psilomelane. In addition, wad and black manganiferous clay often occur in the altered ore beds. Predominate gangue minerals are clay, quartz, goethite, limonite, calcite, orthoclase and carbonates. Others present in lesser quantities are sericite, zircon and tourmaline.

The phosphorus-bearing mineral is difficult to identify and is tentatively considered to be wavellite. All the ore minerals occur in clay beds of either yellow, brown or black color.

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OPERATING IDEAS

Lloyd E. Antonides

BIG LOADS are quickly loaded, hauled fast along road and dumped on run in nice even layers at disposal area in gully.

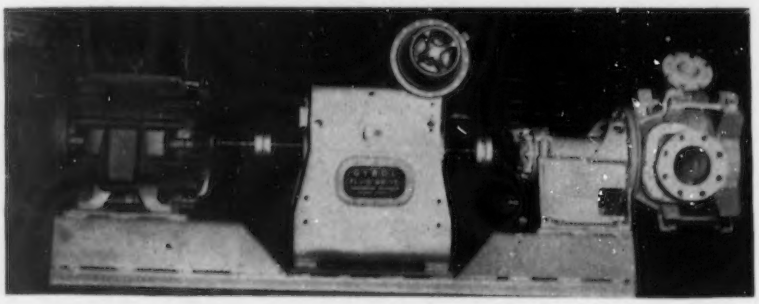
Earthmover Speeds Mine Waste Disposal

HAULING 1,500 to 2,000 tons of mine waste per day from hopper to dump in gulley almost a mile away, needs big rugged equipment that moves fast. In that situation, DeBaldo Brothers, Glenshaw, Pa., chose two Model C LeTourneau-Westinghouse scrapers for their contract to dispose of "boney" for a large coal mine near Pittsburgh.

At this mine, "boney"—a sticky wet slag—is carried to hopper by conveyor belt. In loading from hopper, DeBaldo says the scrapers maneuver well, are low enough to fit easily under chute, and big square top permits loading the 16 to 20 tons quickly. Drivers dismount and load own scraper. Units, having top speed over 25 mph, haul fast along 0.8-mile haul road which is maintained by Adams motor grader. At dump, large low pressure tires give good flotation. And, as DeBaldo points out, scraper's ability to spread waste in controlled layers with machine on run has definite advantages. Not only does it keep operation moving but it lays waste evenly so it dries quickly for firmer footing on later trips and keeps area level without a dozer.

Peter DeBaldo says that while big part of success is operator excellence, "Compared to trucks for same job, scrapers will haul twice the slag, twice the distance at half the cost!"

Slurry Pumping Costs Are Cut



GYROL FLUID DRIVE on 4-in. Type R Morris slurry pump handling varying capacity and head, has improved operating efficiency, cut maintenance and is expected to triple pump life. Previously, changes at this plant had to be met by manually- or mechanically-operated plug valves in discharge line—low in efficiency and high in wear. Slurry, specific gravity 1.3, of sand and other sintered material has temperature of 190 deg F and is pumped from tanks to screens. Capacity varies from 300 to 500 gpm and head from 45 to 105 ft. New hook-up permits varying pump rpm from 800 to 1100 while 40-hp electric motor stays at 1160 rpm. Plug valve is eliminated.

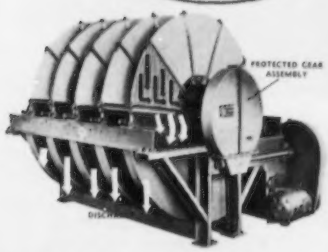
Movable Pump House Is Handy

STEEL TANK houses sump pump at asbestos pit of Flintkote Mines Ltd., north of Thetford Mines, P.Q. Cylinder of ⅛-in. plate is 5 ft in diameter by 12 ft high and has attached sling on outside for easy moving with power shovel. Old dryer tires are used as counterweights around bottom. Ladder and bracket for catwalk give ready access to hinged door in cover. Pipe on outside contains floatball for actuating electric powered centrifugal pump on floor inside. Main pump is rated for 1500 gpm against about 100-ft head. Ladder, electric strip heater, electric light and automatic electric cellar pump are also installed inside. Small house on legs is portable power substation. G. M. Gibbs is manager of property and A. G. Tiede, mechanical supervisor.

DENVER CAN SUPPLY COMPLETE EQUIPMENT FOR YOUR MILL

One Responsibility

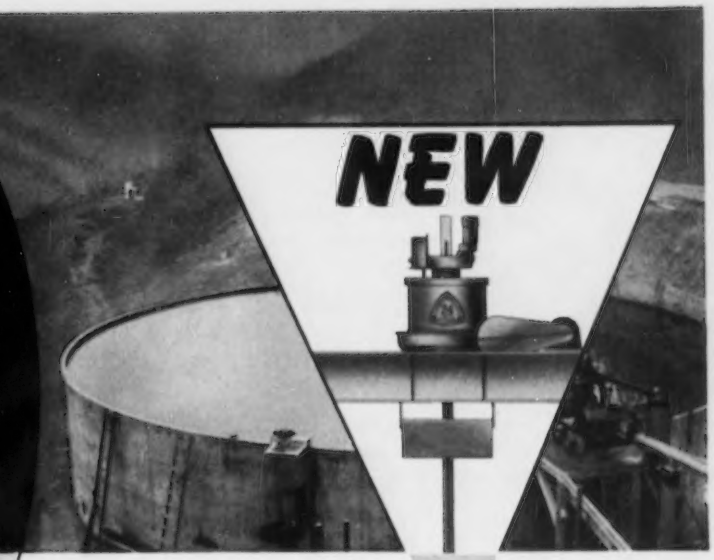
Crushers, Screens, Feeders, Ball-Rod Mills, Classifiers, Jigs, Pumps, Samplers, Agitators, Conditioners, Flotation, Thickeners, Filters, Dryers, Ore Testing and Mill Design Services.



DENVER DISC FILTERS
Give You These Advantages—

- DRIER FILTER CAKE, with positive gravity drainage of filtrate before blow-off.
- LOWER MAINTENANCE COST—all wearing parts are designed for long life.
- LARGER FILTER AREA per unit of floor space.
- WIDE OPERATING FLEXIBILITY—Two or more products can be filtered at the same time.
- Available in sizes from 2' - 1 disc to 9' - 12 disc.
- Drum Filters also available.

WRITE FOR BULLETIN NO. FG-81.



DENVER High Capacity THICKENER is Completely *AUTOMATIC*

PROBLEM

Today's *new thickening techniques* require a new, high capacity thickener.

New flocculating agents that increase settling rates from 200% to 1000% mean *thickeners must move high tonnage* of fast settling solids and *handle overloads that build up fast.*

Faster settling takes place in less area and permits economy of smaller diameter thickeners.

SOLUTION

Spiral Rakes on DENVER *High Capacity* THICKENERS move solids to discharge in one revolution.

Completely automatic rake control handles overloads without attention and prevents damage to mechanism.

Low cost beam superstructure is used on sizes to 65' diameter. Simplified truss or bridge type is used from 65' to 125'.

COMPARE SPECIFICATIONS—PRICE

Every engineer planning a new thickener installation will want to study DENVER specifications. Compare sand raking capacity; shaft diameter; rugged, heavy-duty construction; totally enclosed, running in oil gears; automatic, foolproof rake lifting controls; acid-proof or standard construction; quick delivery.

You will agree the NEW DENVER *High Capacity* THICKENER more adequately meets ALL requirements of today's new thickening techniques.

"The firm that makes its friends happier, healthier and wealthier"

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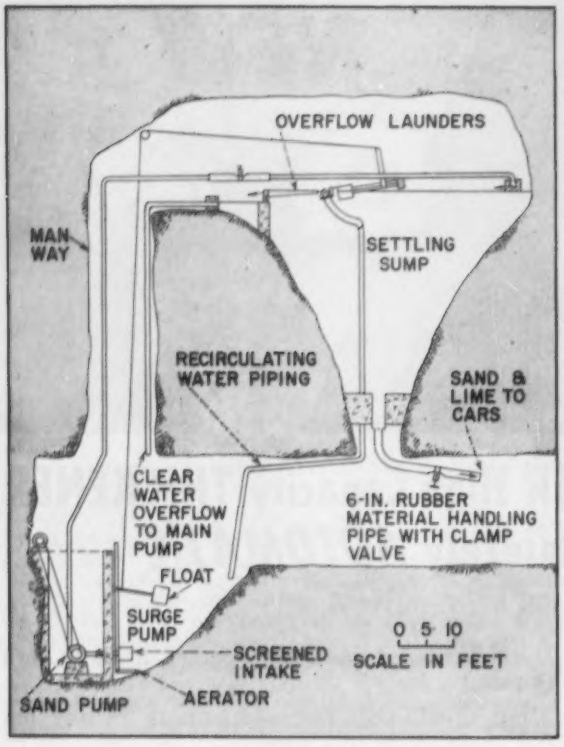

Sump Is Quick-Cleaning

SLIME FROM THIS SETTLING SUMP can be simply drained off without any other cleaning down, says A. R. Meyers, chief engineer, Canadian Malartic Gold Mines Ltd., Malartic, P. Q. Arrangement consists of surge sump which receives drainage, sand pump pit, pipe and manway, and conical settling sump. Not shown in drawing is main pump and sump which handle clear water overflow from settling sump. Floats permit continuous operation of sand pump by recirculating water from settling sump to surge sump if water level in surge sump falls too low.

Since cost is about $5,900, including indirect charges but not pump and motor, it is practical only where slime cost is high or in fairly permanent spot. Canadian Malartic has one at bottom of main production shaft and similar ones at main ore pass chutes. Main pump maintenance and ditch and ballast cleaning has dropped considerably as a result. First one is four years old. They use SRL 2½-in. sand pumps and drain off 2 or 3 cars of slime a day, which keeps sump clean and unsolidified. Production shaft installation eliminated shaft sump and bottom is concreted at floor level.

Tunnel Jumbo Is A Giant

THIS HUGE RIG has been put to work on an 860-ft-long tunnel for the Mayfield hydroelectric dam of Tacoma, Wash., City Light on the Cowlitz River 30 miles southeast of Chehalis.

A Euclid crane provided the chassis for the machine which was designed and built by Frank Gibson and William J. Roberts of Spokane, Wash. It mounts six pneumatic percussion rock drills on hydraulically controlled arms, two on each of three levels. The uppermost of two work platforms which cantilever from the rear, can be hydraulically raised to 20 ft above the ground level. The self-propelled jumbo rolls on 6-ft diameter rubber tired wheels. It weighs 65,000 lb and cost about $30,000.

Two tunnels will be driven—one 46 ft in diameter; the other, 26 ft. The drilling jumbo is backed up against the rock face, and up to 120 holes are drilled to give a typical arched tunnel section. Roof jacks can be seen on the top of the up-right posts carrying the platforms. Use of rock bolts and pierced steel landing mat for supporting ground is also apparent.

Gibson and Roberts have subcontracted the job from L. E. Dixon Co., which has the $10-million contract for the dam.

Pit Men: Summer's Comin'

NOW THAT THE BOYS are starting to leave the warm "hearth stone" and doing their yakking outside the shed, it's time to prepare your vehicles for the hot weather ahead.

In addition to normal preventive maintenance, watch the cooling system. As DuPont, Bureau of Standards and other authorities say: "Get rid of that anti-freeze." Permanent means only winter long, not year after year. Air and exhaust gases, always seeping in, oxidize the glycol to acids that produce passage-clogging rust. The hydrometer proves nothing as far as acidity goes and adding more inhibitor does not eliminate acid salts already formed. Drain and discard it, flush system, clean with chemical, and flush again. Check for leaks. Replace or repair where needed. Don't forget to clean the outside of radiator. And check the pump pulley and belt for slip and wear. Then refill system and add a rust inhibitor.

Next on the list should be oil and lubricants. Flush out the winter grade to get rid of collected dirt. And check the manual for correct replacement.

Better clean her up inside and out. Not only do clean surfaces cool better but you can see any cracks that need welding.

POWERHOUSE ...one D397 does it all!

In one of the world's largest phosphate beds, near Soda Springs, Idaho, this CAT* D397 Electric Set is the main source of power for the crushing plant shown here. Output of the crusher, owned by Morrison-Knudsen Co., Inc., is 1000 tons per eight-hour day of 1½"—⅜" quartzite. The crushed quartzite is raw material used in Monsanto Chemical Company's nearby elemental phosphorus plant.

The D397 Electric Set furnishes power for a 125 HP motor on the Simmons cone crusher, a 100 HP motor on the Cedarapids jaw crusher, and nine motors totaling 172½ HP on conveyors and vibrator screens.

Now there is a new Caterpillar D397 Electric Set with Turbocharger, developing 350 KW. It is self-regulated for easy, adjustment-free operation and steady voltage. It incorporates Caterpillar's amazing new generator, which exactly matches the D397 Engine powering it.

Reliability and long life are important in an electric set, which is often called upon for continuous operation. The Caterpillar D397 has both, with such features as aluminum alloy bearings, "Hi-Electro" hardened crankshaft and cylinder liners. It also has highly effective oil and air filters designed to protect the engine's Caterpillar-built precision under even the dustiest conditions.

There is a complete line of Caterpillar portable and stationary Electric Sets, up to 350 KW. Your Caterpillar Dealer — who provides skilled service and parts you can trust — has full details on the engine or electric set best suited to *your* operation. See him today.

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THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

How Critical Is It?

The United States is running into a serious shortage of scientists and engineers. There is no novelty in this observation. It has often been made in the last few years. And there has been mounting alarm about what this shortage may mean for both our national security and our prosperity.

There would be great novelty, however, if general agreement were attained on such important matters as the size of the shortage, the extent of the damage it threatens to inflict, and the best ways to eliminate it. The purpose of these editorials is not to provide this novelty, but to ventilate some of the key aspects of the shortage of scientists and engineers.

This first editorial in the series is designed to throw light on the over-all dimensions of the shortage. Others to follow will be addressed to such questions as:

- How serious is the threat to our economic well-being and to our national security?
- What needs to be done to prevent the shortage from becoming critical?

Rise Has Been Rapid

The problem is *not* that we have been producing a small number of engineers and scientists. Indeed, the number has risen sharply. We now have a working force of more than 600,000 engineers, over twice as many as the 286,000 there were in 1940. And we have about 250,000 scientists (chemists, physicists, biologists, geologists, mathematicians, etc.), compared to only 92,000 in 1940. About one in 148 persons in the labor force of 1940 was a scientist or engineer; today the ratio is about one in every 80.

In research and development work, where highly creative scientific minds are required, there has been fully as rapid a rise in employment of scientists and engineers. Fewer than 90,000 were employed in research and development fifteen years ago; the total now exceeds 200,000.

—But Not Rapid Enough

Despite this rapid increase in the number of scientists and engineers—at a rate much faster than the increase in the labor force as a whole—the needs of industry, government and education for technically trained people have risen even more sharply.

The principal reason for this mounting demand is the prodigious growth of research in the last 15 years. From a total of only about $900 million spent on all types of research in 1941, the annual expenditure rose to over $5 billion by 1953 (the latest estimate available). Over two-thirds of the research is done by private industry, mostly to develop new and better products and to find new and better methods of production. Most of the rest is performed by the government, largely to develop improved and inevitably more complex scientific weapons.

One aircraft company has found from its own experience that it required 17,000 engineering manhours to develop a typical fighter plane in 1940. The requirement is now about 1.4 million engineering manhours. Development of the typical fighter plane of 1960 will require well over 2 million engineering manhours.

In this dramatic example, the need for engineering services for a basic piece of military equipment soared 80 times in 15 years. It is an indication of why the demand for more and more technically trained men and women has outstripped even the imposing increase in scientific and engineering manpower of the last decade and a half.

Size of the Gap

Exactly how great the gap is between the available supply of scientists and engineers and the number required, it is impossible to say. In some instances technical talent undoubtedly could be better used than it is now. And part of the shortage might "disappear" if higher salaries had to be paid. (These questions will be discussed in later editorials.) But informed estimates of the approximate size of the gap can be given.

- According to the best available information, from estimates by the Engineers' Joint Council and the U. S. Bureau of Labor Statistics, **the minimum need for engineers from graduating classes is 40,000 each year for the next ten years.** Last year we graduated only 23,000 engineers, just about enough to cover replacement needs without allowing for any expansion of the number of active engineers. Projections made by the U. S. Office of Education indicate that we shall probably not have a class of 40,000—the *current* annual requirement—until 1963.
- According to Dr. Howard Meyerhoff, executive director of the Scientific Manpower Commission, **there is now a shortage of about 20,000 scientists.** Last year the number of doctoral degrees in the natural sciences, almost a prerequisite for research work, was only 5,000. Dr. Meyerhoff estimates that the shortage of scientists will rise another 30,000 by 1960.

More Needed As Teachers

Not all of the graduates with scientific and engineering training, furthermore, will work as scientists and engineers—that is, by performing research and giving it practical application. Such training is now necessary in many sales and management positions. And more of our technically trained men and women must remain in educational institutions as teachers if the quality of engineering and scientific education is to be maintained. A survey in 1954-55 by the National Education Association showed that, out of 277 universities, state colleges and large private colleges, nearly one-third *already* had unfilled vacancies in engineering and three-fourths had vacancies in physical sciences.

The dimensions of the shortage of scientists and engineers can be summarized as follows: **Despite a substantial rise in the trained manpower available, the needs of industry, the government and education have risen still faster. The best information indicates that, on the basis of current and anticipated needs, our recent yearly rates of production of slightly over 20,000 engineers and about 5,000 PhD's in natural sciences could be doubled without closing the gap entirely.**

The disturbing implications of this shortage for our national security and our prosperity and some practical suggestions for eliminating it will be the subjects of subsequent editorials in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Official Cites Wyoming's Resources

CLASSIFYING WYOMING as the "baby" of the Rocky Mountain states, as far as development of its mineral resources goes, Bureau of Mines Regional Director John H. East Jr. says that potentially the state is one of the richest mineral treasuries in the country.

"Wyoming has never been properly prospected for minerals, excepting the major base metals, such as copper, lead and zinc." Even among this latter group, the prospecting has been sketchy and unorganized, he added.

Among the valuable ores which have not been looked for, or prospected for only to a very slight extent, the director listed titanium, zirconium, rare earths and even uranium ores. "In spite of the finds in southern Wyoming, vast areas remain that have not been prospected for uranium," he stated.

In this connection, East quoted a statement from the Atomic Energy Commission, which said that Wyoming is potentially richer in uranium than the Colorado Plateau.

Besides the unknown mineral deposits which await discovery, the state has not developed its known reserves at a rate comparable to other states. Gigantic coal deposits are known; in fact, Wyoming has one of the biggest reserves in the nation, he said. Some deposits are being worked only to a limited extent, however, and others are not being worked at all.

Because of this huge reserve, East said that coal is one of the state's most valuable minerals. He mentioned charcoal for power and coal tar for the plastic industry as two important by-products, when Wyoming coal finds a larger market. Local coal may also have an important future as a source material in the making of liquified coal-petroleum products, he added.

Anorthsite and aluminum clays, source of alumina, phosphates for fertilizer, and shale oil (kerogen) are other minerals proven to exist in large quantities, yet undeveloped, he said.

One reason for the unknown status of many minerals is the recent development of markets and demand for the uncommon ones, such as zirconium and the rare earths. "The need for them is new within the past five years."

Oil is one mineral which has been developed extensively in the state, but even here, East predicted great expansion. "Not only are there many more fields to find, but many of the present fields have not reached the basement yet," he said. The director cited Elk Basin, which was a small producer for 25 years from a shallow sand, before a driller went on down to make a new discovery, opening the field as one of the country's largest.

The Bureau has a sizable budget for researching better ways of mineral extraction and mining. East estimates his office has been handling about $6.5-million each year, which went into improving mining methods, oil shale research, the Bureau's regular metallurgical program and publication of the *Minerals Yearbook*. Another $2-million in cooperative Government-industry funds is also spent annually on coal-use research and other special research projects.

J. H. East Jr.

Before occupying his present position, the director was a mining engineer for many years in Wyoming and other Rocky Mountain states. His region included Colorado, Arizona, New Mexico, North and South Dakota, Nebraska and Utah, besides Wyoming.

Aluminium Ltd. Offers Part Support of African Smelter

ALUMINIUM LTD. has announced its willingness to take a minority interest in a proposed aluminum smelter in French West Africa, the construction of which is being studied by Pechiney, the leading French aluminum company, in association with other European producers of aluminum.

Representatives of Aluminium Ltd. and Pechiney have been holding discussions in Paris which resulted in the signing on March 6 of a joint statement of intentions concerning the smelter project.

The company said the project would provide for the construction of a smelter in French Guinea if the plans of the French and France Overseas authorities for the development of hydro-electric power on the Konkoure River materialized.

Bauxites du Midi, a French mining subsidiary of Aluminium Ltd. has been active in French Guinea for many years and is already mining bauxite on an extensive scale in the territory. The company has been making studies of the feasibility of building new plants and other facilities to mine bauxite more extensively and extract alumina.

Soviets and France Offer Bids for Yugoslav Copper

SOVIET UNION has offered Yugoslavia economic aid for the purpose of exploiting copper ore deposits at Majdanpek, eastern Serbia, it was announced recently. Russia thus joins France, presently negotiating with Yugoslavia, in competition for bid acceptance.

Large quantities of Yugoslav ore exist in the Majdanpek area, though of a poorer quality than the major Yugoslav producer at Bor in eastern Serbia. The Bor Mine was owned by a French company prior to the war.

France, with U. S. backing, is reported to have offered a plant and mining machinery on credit bearing 5% interest. Repayment would be made over a five-year period with copper produced.

The Russian offer, considered more favorable, calls for a 10-year repayment period at 2% interest. Other commodities would be considered for repayment as well as the mined copper. Russian economic aid to Yugoslavia for the year already stands at $194-million.

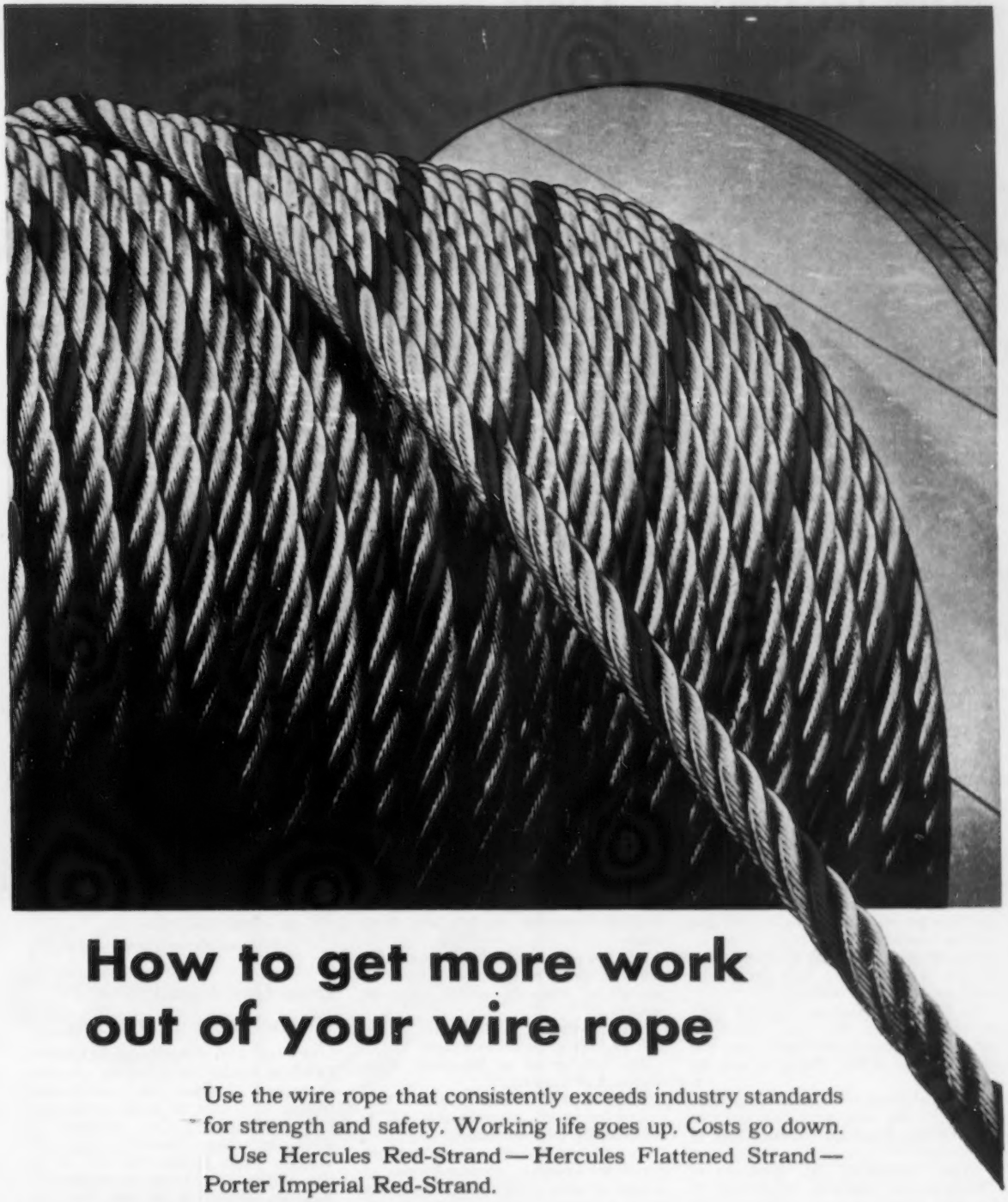
The possibility of exploiting Majdanpek has been under discussion for a number of years. In 1953 a Japanese expert investigated the area and reported to the United Nations Technical Assistance Board on the possibilities of exploitation.

Estimates set production for the area at 23,000 tons of blister copper yearly. Such output would bring total annual copper production for the country to 55,000 tons.

New Sintering Plant Will Handle U. S. Steel Ores

COMPLETION IN 1957 is forecast for a 15,000 tpd sintering plant, being built at Houseville, Pa. by U. S. Steel Corp. Cost of the facility has been estimated at about $30-million.

The three-unit plant will handle ores from the Mesabi operations of the parent company and its subsidiary, Oliver Mining Division, and will receive foreign ores as well.



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Mining Companies Intensify Searches

ANNUAL REPORTS of the major mining companies of the world show an ever-increasing drive to find and exploit the minerals which a prosperous Free World requires. Continuing last month's summarizations of the releases of the major extractive industries (*E&MJ*, April 1956, p 73) the following brief digests include stories of diversification into new minerals, intensified exploration, and expanded production of vital metals.

Anaconda Co. shows a 1954 net profit of $65,256,306. Newest enterprise put on stream was the Anaconda Aluminum Co., Columbia Falls, Mont., which went into production last August.

Leaching plant facilities for limestone ore went on stream last July at Blue Water. Acid leaching plant had two units in operation by January 1956.

In the copper market, Anaconda produced 1,070,502,023 lb copper from its domestic and foreign mines and from material purchased or treated for customers.

Greater Butte has ore reserves of 100-million tons, 0.8% Cu in the open-pit area south of the Kelly shaft. Kelly mine production was stepped up to 15,000 tpd ore. An additional 3,000 tons comes from Skyrme and Shannon each day. Berkeley pit, established in the area south of Kelley, stripped overburden and reached ore by year-end. Starting with 3,000 tpd, this pit will hit 10,000 tpd by end of 1956 and 17,500 tpd by mid-1957. In the northwest portion of the Butte District, a new shaft, the Ryan, is planned for this year. Shaft will disclose size of new orebodies found in this area. Expansion program at Anaconda concentrator to handle Berkeley pit ore was started in 1955 and will be completed in 1957.

Anaconda Aluminnum Co., started in August, was at 5,000 tons per month rated capacity by December.

In Nevada, Yerington operated satisfactorily through the year, added reserves. Leviathan sulphur production was maintained to satisfy Yerington acid demands.

In California, Darwin operated throughout the year, producing lead-zinc concentrates. Shoshone resumed work in November.

Chile Exploration Co., operators of Chuquicamata, produced 461,481,842 lb Cu, plus additional gold and silver. The request to spend $20-million on plant expansion and $17,300,000 on welfare installations was granted by the Chilean Government. Plant expansion will add 100-million lb to Chuqi capacity.

Andes Copper Co. produced 89,232,461 lb Cu and some gold and silver from Potrerillos, which has only five year's ore supply at present level. Indio Muerto, to be known as the El Salvador mine, has 78-million tons, 1.66% Cu with more to come. Ore from El Salvador will go by adit and rail to new crusher plant 3½ miles from Potrerillos. Crushed ore will travel to Potrerillos by conveyor. Copper production from Potrerillos five years from now will be 200-million lb a year and all the ore will come from El Salvador. Total cost of El Salvador and Potrerillos improvements will be $53-million.

Sanitago Mining Co. is developing La Africana. This $2-million project will be producing 8-million lb copper annually by 1951.

Cananea Consolidated Copper Co., S. A., Mexico produced 65,749,100 lb Cu and some gold and silver.

American Metal Co., Ltd. reported net income for 1955 at $19,809,694, an increase of 20% over 1954. Expansion in 1955 called for an expenditure of $7,150,000 for properties and replacements and $1,480,000 for new investments in mining companies. New mining investments include Heath Steele Mines, Ltd. and increased interest in Copper Range Co. (White Pine).

For 1956 and subsequent years, the company has authorized expenditures of $15.5-million for expansion and development; $9,250,000 for Heath Steele; $2.3-million for research and development; and $5-million for mineral exploration, oil and gas.

Heath Steele Mines will be in production by 1957 at 1,500 tpd. One shaft is down far enough to permit two level development work, another is being sunk. Mill design is in progress.

The company's lead-zinc operations in Mexico managed to show small profit. Improved tax situation is necessary, according to American Metal, before the Mexican resources can be fully developed.

Carteret copper refinery produced 207,400 tons metal or about 14% of U. S. production. Platinum refinery was expanded.

Lead production in Mexico was 82,400 tons or 37% of Mexico's output.

Zinc production at Blackwell, Okla. remained at capacity.

Southwest Potash Corp. started a $2.5-million expansion program that will be complete by this summer.

In addition to copper and lead produced, the company produced some 28-million oz silver at its Carteret and Monterrey refineries.

Mufulira Copper Mines Ltd. net profit was $17,903,082 and production was 96,350 short tons, with tankhouse capacity set at 72,000 short tons cathode copper; Chibuluma Mines Ltd. began hoisting ore, is almost at full mining capacity; Baluba Mines Ltd. and Chambishi Mines Ltd. are being held in reserve; Roan Antelope Copper Mines Ltd. net profit was $16,583,725 and mine production was 92,620 short tons. An electrolytic plant is under construction at Ndola, will have 55,000 ton capacity and this will be raised to 110,000 long tons shortly.

New Jersey Zinc Co. reported a net income of $4,826,284. During the year $1,244,810 was spent on prospecting and exploration in U. S. and Canada. Further work is planned at the Navajo Indian Reservation in joint effort with the Texas Co. and Shattuck Denn Mining Co. Other exploration projects are underway with Texas Co. and Gulf Oil.

A total of $4,995,000 was spent on new mines and mine development. Sterling mine was on schedule, except for strike period, in its attempt to double production rate. Friedensville is progressing underground, mill will get started this year. Austinville, Mineral and Gilman were at capacity during the year. Development work at Jefferson City and Treadway was approaching production. Hanover and Magdalena were reopened.

Production at Palmerton was 21% above previous year. A by-product treatment plant to make cadmium metal was installed. Production at Depue was at capacity. Roasting operations at Canon City were suspended in September, then resumed in October to supply material for Depue and Palmerton.

Quebec Iron and Titanium Corp. produced 106,292 tons iron and 143,742 tons titanium-slag during the year. Iron capacity is 180- to 200,000 tons from five furnaces. Three more are planned. With a patent on a new continuous titanium tetrachloride process, the supply of slag at Quebec Iron and a good metal-making process, New Jersey Zinc is coming closer to actively entering the titanium metal field. A 5-ton tetrachloride pilot plant will be started this year.

(*Annual Reports continued p 200*)

Iron Ore Firms Study Quebec-Labrador Area

LOW GRADE iron prospects on the Quebec-Labrador border are attracting attention of major U. S. firms. One prospect, containing 30% iron, is being investigated by Cartier Mining Co., subsidiary of U. S. Steel Corp. Location is near Mt. Wright, which is also the site of the new Hilton mine, being investigated by Pickands, Mather & Co. and Steel Co. of Canada. (*E&MJ*, April 1956, p. 122).

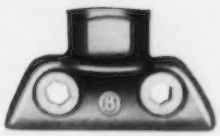
A new corporation, Mattagami Mining Co., Ltd., is being formed to acquire other claims in Ontario, the president of Steel Co. announced.

Yuba Dredge to Korea

YUBA CONSOLIDATED GOLD FIELDS, largest gold dredging operator in California, has sold one of its fleet of eleven dredges for use in southern Korea, where a

Insulated Hangers

1



Trolley Wire Clamps

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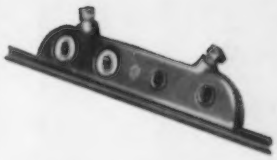

Feeder and Trolley Splicers

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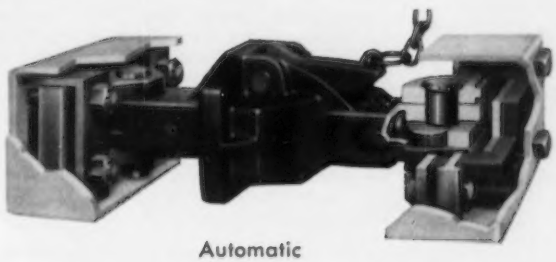
Combination Feeder-Trolley Clamps



Automatic Couplers

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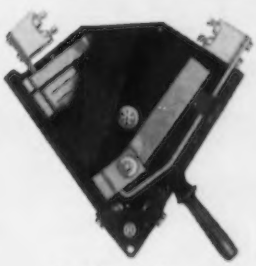

Feeder Safety Switches
(cover removed)

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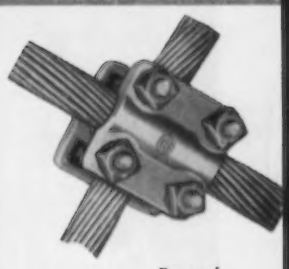

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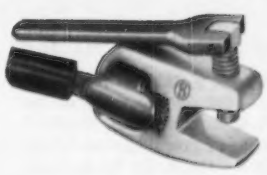

Rail Clamps

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Expansion Bolts

9

Current Collectors

10

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11

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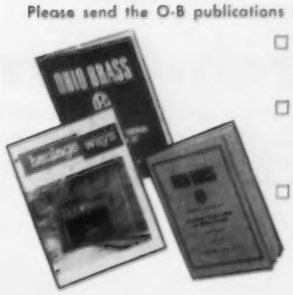

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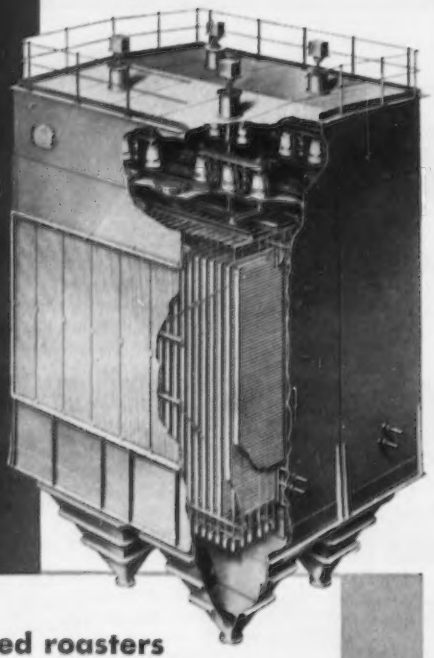

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Yuba *(Continued)*

UN reconstruction agency has signed contracts in the amount of $521,500 to cover working of gold-bearing ground. Yuba Manufacturing Co. will dismantle the dredge, reconstruct it for Korean requirements at the Benecia plant, and move it from Hammond, Calif. to the erection site. Proposed sector is estimated to contain some $3-million worth of recoverable gold.

Mining Calendar

Industrial Nuclear Technology Conference, on uses of radioactive materials in industry, including radiation sources and nuclear instrumentation. Co-sponsored by *Nucleonics* magazine and Armour Research Foundation. Chicago, Ill., May 15-16.

11th Purdue Industrial Waste Conference. Purdue University, Lafayette, Ind., May 15-17.

Materials Handling Conference, Society for Advancement of Management, New York City, May 17-18.

Engineering Industries Exposition, N. Y. State Society of Professional Engineers. Statler Hotel, New York City, May 17-19.

International Diamond Drilling Conference, sponsored by Canadian Diamond Drilling Assn., Royal York Hotel, Toronto, May 31-June 2.

Conference on the Physics of Nuclear Reactors, Institute of Physics, London, England, June 3-6.

Fourth annual Human Engineering Institute. Stamford, Conn., June 18-22.

Annual meeting, American Society for Engineering Education. Iowa State College, Ames, Iowa, June 25-29.

10th meeting, European Assn. of Exploration Geophysicists. Hanover, Germany, June 25-29.

Rhodesian Manganese Mining

A START has been made on the exploitation of the extensive manganese ore deposits at Fort Roseberry in Northern Rhodesia. Thus far, no attempt had been made to open up the strike because demand for the ore did not warrant the expenditure involved. Now, Rhodesian Vanadium Corp., a subsidiary of Vanadium Corporation of America, is sending 300 to 400 tons a month of ore to Mufulira. It is shipped from there to the U. S.

Vanadium Corporation of America exercised its option to buy the mining concession at the end of September last year. The price was $1-million dollars.

Ten More for DMEA

INCLUDED among ten contracts executed during March 1956 by Defense Minerals Exploration Administration were: one for manganese in California; two for tungsten and one lead-zinc in Colorado; one

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DMEA *(Continued)*

thorium, uranium and rare earths in Hardin County, Ill.; three for mica in North Carolina; and two for uranium in Utah. Thirteen others have been approved by the agency but not yet executed by the various applicants.

Aluminium Ltd. Aims For 1-Million Ton Output

$2.50-MILLION will be spent by Aluminium Ltd. to develop 800,000 hp on the upper Peribonca River in northern Quebec, according to announcement by Nathanael V. Davis, president.

Davis told shareholders that the power would be used to support a minimum of 150,000 tons of new aluminum smelting capacity in the Saguenay district, where Alcan's Arvida smelter is located. "Construction will begin shortly," Davis said, if Aluminum Co. of Canada-Quebec government negotiations prove fruitful and other studies work out.

Assuming early advancement of the scheme and continued progress at Kitimat, the firm's president noted that the company's Canadian aluminum capacity would be increased to more than 1-million tons at the end of 1959.

Falls of Ground Reduced

INTERNATIONAL Campaign for Prevention of Falls of Ground Accidents, which began Jan. 1, 1955 and ended Dec. 31, is credited with a 29% reduction in frequency of injuries over the previous two years. An estimated 260 chargeable injuries, 15 probably fatal, were avoided through efforts of the National Safety Council's mining section and enthusiastic cooperation of underground workers.

Bolivia Annuls Concession

A SUPREME DECREE issued by the government of Bolivia in late April has annulled a gold concession granted in August 1955 to Southern Heater Corp., of Compton, Calif., because the firm "has not fulfilled the established conditions for the contract. . . ." Concession now reverts to the government.

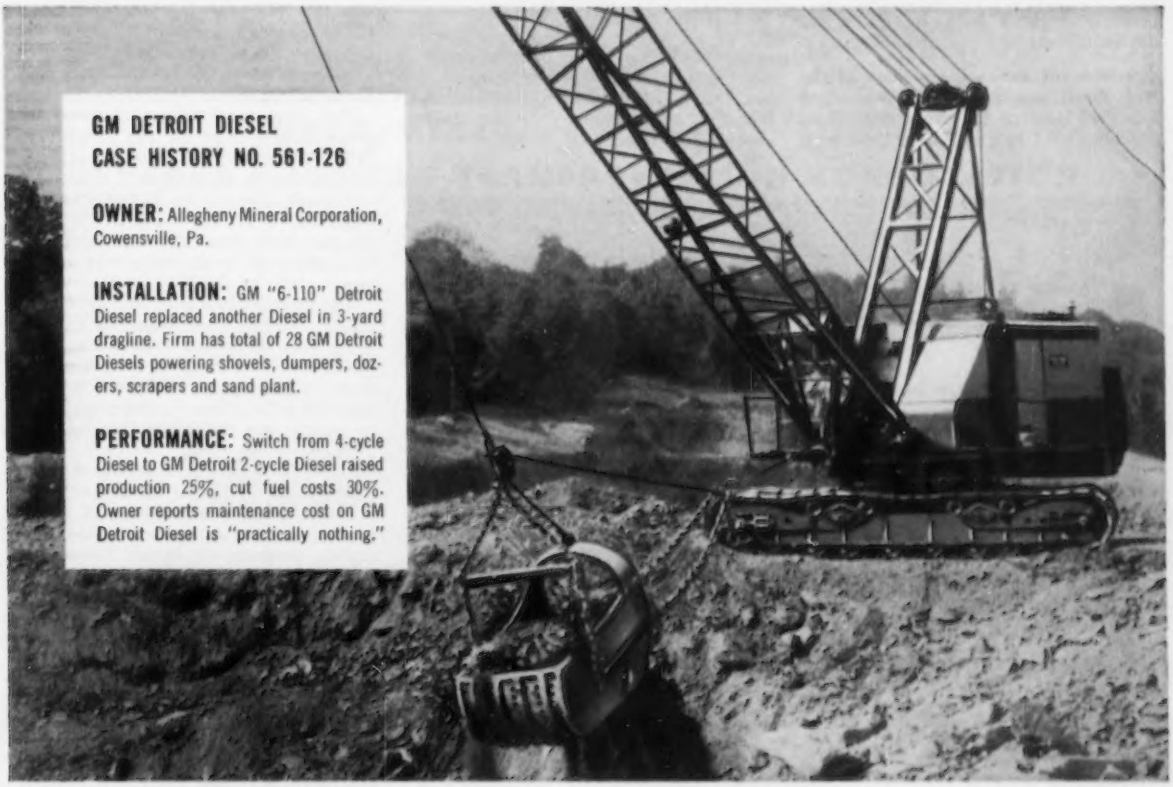
IN THE U. S.

ALASKA

Diamond drilling is continuing at Funter Bay nickel-copper lode of the Admiralty Alaska Gold Mining Co. Some 25 holes have been drilled since a year ago, but at present the program is on a private contract basis rather than DMEA-financed as most of the work has been. Results are reported to be continually encouraging. Company now reports they are planning to extend the main adit in the hope of cutting the nickel lode about 1200 ft

Production Up 25%
Fuel Costs cut 30%

Since He Switched to GM Detroit Diesel Power



GM DETROIT DIESEL
CASE HISTORY NO. 561-126

OWNER: Allegheny Mineral Corporation, Cowensville, Pa.

INSTALLATION: GM "6-110" Detroit Diesel replaced another Diesel in 3-yard dragline. Firm has total of 28 GM Detroit Diesels powering shovels, dumpers, dozers, scrapers and sand plant.

PERFORMANCE: Switch from 4-cycle Diesel to GM Detroit 2-cycle Diesel raised production 25%, cut fuel costs 30%. Owner reports maintenance cost on GM Detroit Diesel is "practically nothing."

PRODUCTION UP, fuel costs down, maintenance expense slashed—that's what hundreds of operators report after their switch to General Motors Detroit Diesel power.

And the reason is clear.

They get extra production with a GM Detroit Diesel because a 2-cycle engine delivers twice as many piston power strokes per crankshaft revolution as a 4-cycle engine.

They pile up worth-while records of fuel saving as evidenced by this Pennsylvania user's report—so typical of others who are profiting by switching to Detroit Diesel engines.

And one reason maintenance costs drop is that GM Detroit Diesel parts cost less. For example, valves, pistons, rings, liners, bearings and other replaceable parts cost less than for most other Diesels.

But get the full story on GM Detroit Diesel power from your GM Detroit Diesel distributor or dealer. Call him today—or write direct.

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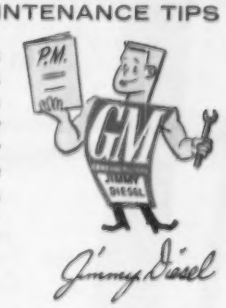
Your GM Detroit Diesel is built for a lifetime of hard work. But you'll get better service from your engine if you have your GM Detroit Diesel distributor or dealer set up a preventive maintenance program for you. Call him today and remember—Preventive Maintenance Doesn't Cost, It Pays.



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Alaska *(Continued)*

lower than the present working level. Twenty claims there have been filed for patent and 25 more have been surveyed for patent. Two other properties with which W. S. Pekovich is associated have large groups of claims which have been filed for patent: the Alaska Empire gold property at Hawk Inlet, 46 claims, and the Snettisham iron property, 18 claims.

Operation of the recovery plant at the Red Devil mercury mine commenced Feb. 27. Most of the usual mechanical problems of a new operation have been solved. The tonnage treated has gradually increased to the present rate of about 35 tpd. Quicksilver recovered is reported to be approximately one ton per day.

Northwest Ventures, Ltd., of Vancouver, is now diamond drilling copper holdings on Gravina Island near Ketchikan. They plan to complete 5,000 ft. of drilling in the next few months in relatively shallow holes put down into the reportedly extensive surface showings. A larger drill for deeper holes will be obtained if the preliminary drilling shows encouraging results.

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ARIZONA

Arizona copper production in 1956 should top 500,000 tons—peaking 1955's record 452,000, says Robert I. Manning, director of the state's department of mineral resources.

Entry of San Manuel into full production this year (*see E&MJ*, April 1956 p 75), plus accelerated output at Lavender Pit at Bisbee and Silver Bell and Pima mines in Pima County will make this possible.

The latter three mines accounted for about 35,000 tons of new copper in 1955. Add to this the extensive exploration spurred by 46c copper.

The old, mineral-rich Twin Buttes area southwest of Tucson is one of the more popular these days; two big companies have research work under way in the area.

The Banner Mine is in operation, mining and milling more than 500 tpd and is carrying on further exploration.

And the Pima mine—a 1952 discovery made by geophysical methods— is clearing away a 200-ft overburden preparatory to getting into full production by early 1957.

Up to 1951, the area produced more than $25-million worth of copper.

Duval Sulphur and Potash Co. has been carrying on extensive diamond drilling on property on option from Coronado Mines, Inc. This land consists of 10 mines on 163 unpatented claims. Though drilling reports are kept confidential, it is reportedly expected to be bigger than either Banner or Pima.

Other extensive exploration is being conducted by the American Smelting & Refining Co., whose holdings include the Silver Bell mine southeast of Tucson.

Copper deposits throughout the area generally are of low grade, few running better than 1%.

Pima Mining Co. believed at first it possessed only a small—but high grade—property. The ore tested as high as 6%. Drilling showed a large low grade ore area extending out from the high grade body.

That influenced decision to switch to an open pit. Paul W. Allen, general manager for Pima, says a plant to treat 2,000 tpd ore will be built with concentrates shipped to a smelter.

Banner has a capacity of 550 tpd and this will be doubled, reports Allan B. Bowman, general manager.

Banner also is doing additional exploration work 7 miles south of its present operations.

Ray Mines Division of Kennecott Copper Corp., has won the National Safety Council's Award of Honor for 1955. Robert A. Willoughby, Ray Mines safety engineer, said the award recognizes an accident frequency rating 58% better than the Safety Council's par for the division, and an accident severity rate improvement of 93% above par. The Safety Council uses one-half of the total injury rate of the past three years plus the rate of the entire metal mining industry for the same period.

The Ray Division won the Council's

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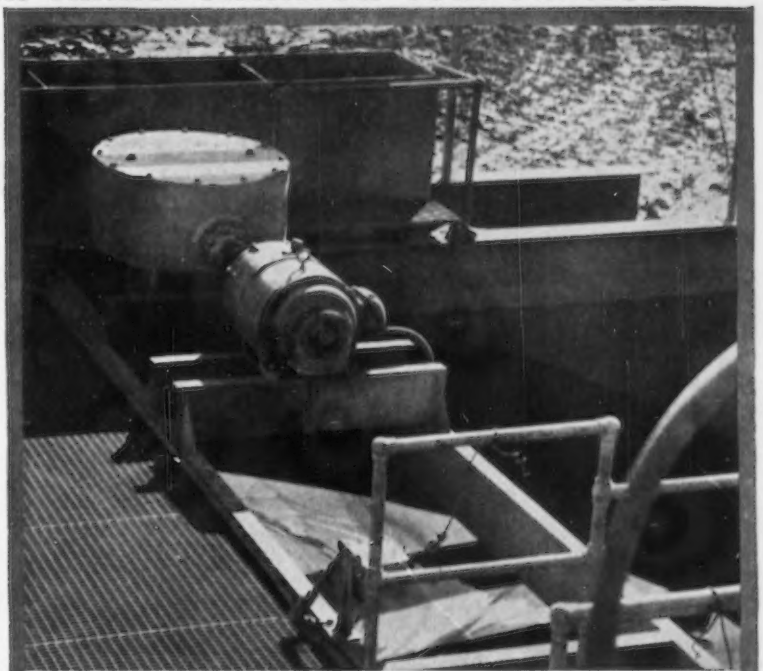

One of the two Turbo-Mixers installed in 1941 at Universal Atlas Cement Company at Northampton, Pennsylvania, in cement slurry suspension.

Today, after *100,000 hours* of heavy-duty, *24-hour service*, these Turbos continue to operate with no more than normal plant maintenance. They are typical of the thousands of Turbos operating in continuous-flow processes where "down-time" is critical—where low maintenance is essential.

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Arizona *(Continued)*

award of merit in 1953 and the underground division, closed in 1955, the U. S. Bureau of Mines' Holmes Award for Safety in 1953.

CALIFORNIA

Verdi Development Co.'s uranium mill at Soledad Mountain near Mojave, Kern County, was shut down in March after four months of operation. Operator was not able to produce a concentrate measuring up to the Atomic Energy Commission's minimum of 70% sodium uranate U_3O_8. During the initial phase of mill operation, grade produced was 15%. By January the grade had been improved to 50%. Ore processed was from Verdi's 2,200 acres of claims near Rosamond, 7 miles south of the mill. Lacking AEC approval to function as a custom mill, Verdi closed down. Present activity is limited to maintenance work. The Verdi mill was the first uranium mill on the West Coast.

Coso Uranium, Inc. has applied for a DMEA loan to carry on exploration work on its 520-acre holdings in the Coso Mountain Range, Inyo County. Company presently is working nine men in exploration work and has stockpiled more than 100 tons ore preparatory to making another shipment. Coso shipped 300 tons last December.

Attention is being concentrated at the point of discovery in No 8 shaft. Company has tapped a lake bed orebody and blocked out an area 800x150x50 ft—an estimated 425,000 tons with an indicated average of 0.20% U_3O_8.

Geologist in charge of exploratory work at the Coso property is Conrad Housley of Long Beach, a 1955 graduate of Calif. Institute of Technology.

A new type of uranium deposit occurring in swampy mountain bogs has been identified in the Sierra Nevada Range in Kern and Fresno Counties, according to the Bakersfield office of AEC.

One deposit occurs at the 5,000 level; another at an elevation of 8,000 ft in the mountain range. Sampling has been encouraging, with some samples going as high as 0.70%. Because of low gamma radioactivity, deposits apparently were bypassed in last year's uranium rush. In many respects, the deposits are thought to be similar to lignites found in the Dakotas.

Production has been discontinued at the Sonoma quicksilver mine near Guerneville. The mine has entered an exploration and development stage that will continue for 4 to 12 months, depending on results.

The J. M. Powelson, president, said the company will spend $300,000 on exploration and development, and application has been made for a $154,000 DMEA loan.

The old workings will be re-evaluated, and exploration will be aimed at extending old ore-bodies and discovering new ones. New ore is indicated both near the surface and underground, Powelson said.

"We hope to find enough ore to justify a new shaft and a new mill," he said. The present shaft, he added, has reached its economic depth—975 ft. Capacity of the existing mill is 125 to 150 tpd.

Decision to take time out for development was made by management provided by Black Mammoth Consolidated Mining Co., the firm which (along with its associates) bought controlling interest in Sonoma last fall.

The firm has retained Francis H. Frederick, San Francisco, as consulting geologist.

D. W. Moleski is mine superintendent, and E. P. Sheppard was lent by Black Mammoth as geologist.

The company is diamond drilling at the property, and additional drilling will be done under a contract to be awarded soon.

Powelson said negotiations are in progress which may lead to purchase of additional California quicksilver mines.

COLORADO

New lithium deposit has been opened in the Ohio City area of Gunnison County. U. S. Lithium Corp. of Salt Lake City, Utah, is developing a new lithium deposit east of their Brown Derby Mine. It consists of a series of dikes containing spodumene and lepidolite, very closely

LEFT: Weighing a car in motion at Seven Islands. BELOW: Typical control and printing units at Seaboard's Hamlet yard.

Weighs 100 cars in 20 minutes "on the fly"

All iron ore from the new Labrador fields—over 6 million tons in 1955—is weighed in motion by these Cox & Stevens electronic track scales. Installed by Iron Ore Company of Canada at Seven Islands, the scales automatically print-weigh a train of 100 cars in just 20 minutes!

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See what Cox & Stevens electronic track scales can do to reduce weighing costs, speed up delivery, and increase customer service.

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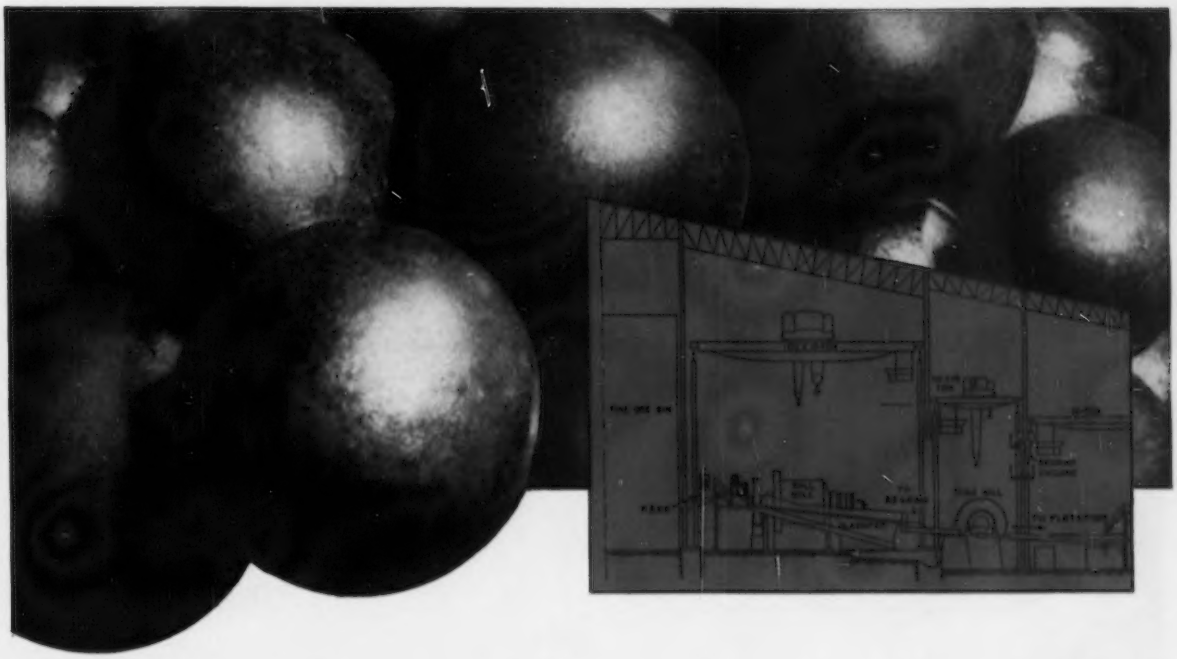

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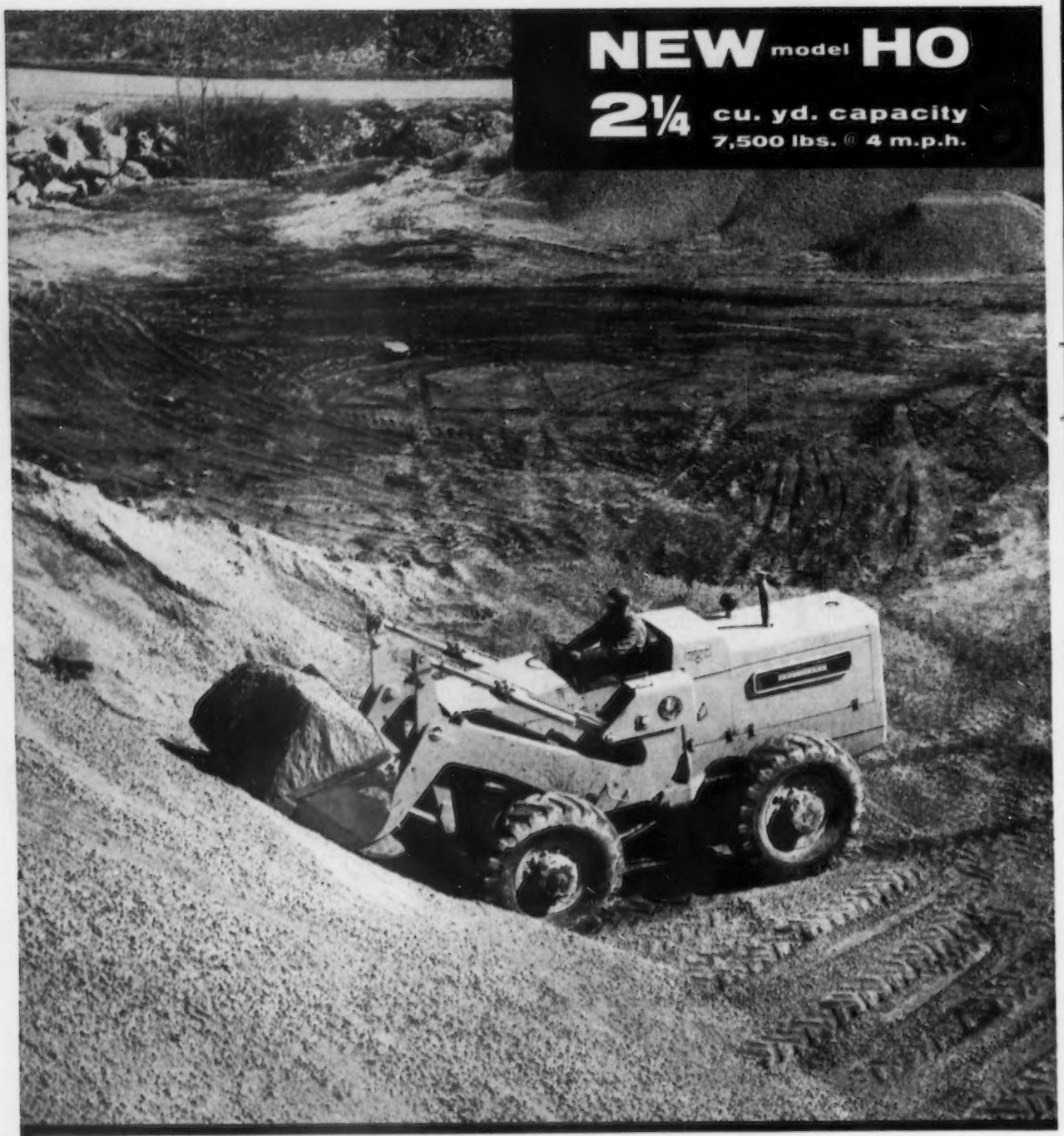

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Digging power: Pound for pound, this "PAYLOADER" has more traction and digging power — for a wider range of ground conditions — than any wheeled tractor-shovel ever built.

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Hydraulic shock absorber: A shock absorber in the hydraulic system smooths out the ride, permits faster load-carrying speeds over rough terrain — with less spillage.

More production, less effort: Power-steer, power brakes (on all 4 wheels), power shift (no "clutching") and good riding qualities also lessen operator fatigue — promote full production all day.

Stay-clean hydraulic system: The hydraulic system is closed and pressure-controlled to keep air and dirt out — reduces oil foaming, lessens trouble and prolongs life of all hydraulic system parts.

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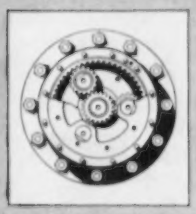
Torque-proportioning differentials, an exclusive feature, assure effective traction under slipping conditions. If one wheel starts to slip, more power is delivered to the opposite wheel. Rugged planetary final drives in the wheel hubs, plus hypoid differential gearing, keep torque low in axles . . . prolong life of axles and all drive train parts.



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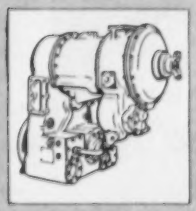
The fastest and easiest-operating transmission you've ever seen. All shifts can be made instantly on-the-go, under full engine speed. There's no stopping for a RANGE shift, there's no foot clutch. With the forward-reverse control, the operator can "creep" the machine at full engine speed, in any gear, while maintaining full bucket action . . . all this, plus torque converter drive.



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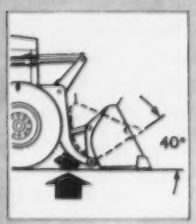
Special pads are provided on the bottom of the boom arms to give ground support for powerful pry-out action. Load forces are also absorbed by the pads, relieving the axles and wheels of these strains. The bucket can tip back 40 degrees, before raising, to get heaped loads even in shallow cuts and low piles and to retain heaped loads.



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Colorado *(Continued)*

intermingled. They strike northeasterly and dip northwest 70 to 85 deg.

Contract with the Denver Research Institute of the University of Denver for development of a new Swedish shale oil process was announced recently by Herbert E. Linden, president of Oil Shale Corp. of California, and Dr. Shirley Johnson, director of the Institute. The $250,000 contract calls for the construction of a 24-tpd pilot plant for testing the new shale-treating process. The plant will be built in the Burnham shops area of the Denver & Rio Grande Western R.R. yards. Competitive bids will be asked on construction of the plant. Linden said this will be the first pilot plant of its kind in the world.

Three Forks Oil & Uranium Co., Steamboat Springs, have taken an 18-mile strip, Columbine to Three Forks Ranch, for uranium. Black light on two specimens shows 0.03% to 0.25% U_3O_8 autunite. Their report on 147 claims says other specimens run from 0.03% to 0.86%. Geologists employed are Sigurd Herness of the Minerals Exploration Co., Fred C. Hahne, Harold W. Blakeley of Golden, and Robert J. Crowley of Grand Junction. D. L. Radcliffe is chief engineer and metallurgist.

Company reportedly proposes to construct a 350-ton mill at Steamboat Springs this season.

Merrill E. Shoup, president of United Gold Mines, says in a letter to stockholders that the Vindicator drainage tunnel lateral, when completed, will open up a huge area of virgin ground at Cripple Creek for prospecting exploration, and development.

"Much of the future of the United Gold Mines Co. depends upon new orebodies that will be uncovered when the drainage is secured by the tunnel lateral," he said. Drainage lateral was advanced 1322 ft last year from the bottom of the Ajax shaft and is now almost to the Ready Money Vein system, one of the big Vindicator producers in that part of the district.

A rich silver strike at the Red Elephant mine of Universal Oil & Uranium Corp. at Lawson is reported. The strike was made on the Girt, a virgin vein in a raise that has progressed 50 ft above the Commodore tunnel. Robert L. Shalk of Denver, president of the firm, said ore assay had increased in value from 330 oz silver per ton where it was encountered in the raise at 25 ft, to 506 oz per ton at the 50-ft level from 8 in. of the vein core, with lead assaying 35%. Assays cut across 30 in. of the vein showed 116.9 oz silver and 6% lead with some copper and gold values coming in.

Silver receipts at the Denver mint for the month of February came to 532,858 oz worth $482,252 compared with 271,743 in February 1955. January 1956 receipts were down to 5,570 oz worth $5,037 compared with 585,159 oz worth $529,271 in January 1955.

Gold receipts at the mint in February were 46,087 oz valued at $1,613,057 compared with 48,066 oz worth $1,682,331 in February 1955.

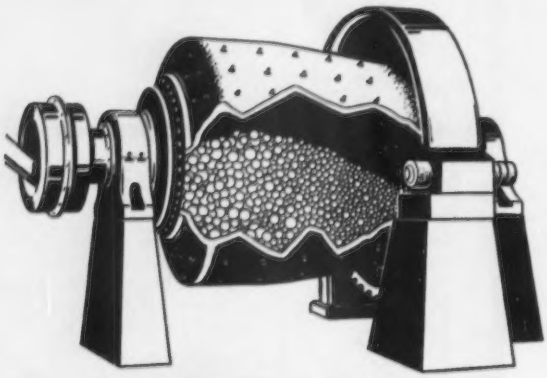
Restoration of 20,250 acres of national forest land to mining location and 1,160 acres of unreserved public land to application for public entry in the San Luis Valley of south central Colorado was announced in late March by Secretary of the Interior Douglas McKay.

About 500 geologists and engineers attended a two-day conference on the geology of uranium April 18-19, held under sponsorship of the Grand Junction Geological Society. Papers were presented by AEC and USGS research geologists, as well as by a number of university professors serving AEC contractors.

Silver ore assaying 506 oz per ton was reported at the Red Elephant mine of Universal Oil & Uranium Corp. at Lawson, Colo. Ore is being delivered to the Dumont mill.

IDAHO

Sullivan Mining Co.'s claim against the Reconstruction Finance Corp. for expenses incurred in connection with stockpiling zinc concentrates for Metals Reserve Co., an RFC subsidiary, has been upheld by the Ninth Circuit Court of



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Idaho *(Continued)*

Appeals in San Francisco. Early in March the appeals court affirmed a U. S. District Court judgment of August 1954, awarding the Sullivan firm $54,864 plus interest at the rate of 6% from Oct. 12, 1948.

Silver Star-Queens Mines Inc. has completed deepening the winze on the Queen footwall vein at its Queens property in Blaine County, near Bellevue, to 160 ft below the 450 level and has applied to DMEA for a modification of its existing exploration contract to permit the cutting of a station and the driving of exploration drifts on a proposed new 600 level. Vein in the winze is reported to be "consistently wide", but mineralization has been sporadic.

Diamond drilling of the Minnie Moore vein is also in progress. A 10-man crew is currently employed at the operation, with Roy Fitz in charge as superintendent.

Polaris Mining Co.'s East exploration lateral from the 3,000-ft level of its Silver Summit shaft into easterly adjoining properties entered Rainbow Mining & Milling Co. property late in January this year and is expected to reach the projected position of "attractive" vein outcrops within the next few months, according to Dr. H. C. Mowery, president of Coeur d'Alene Mines Corp., which owns a controlling stock interest in the Rainbow company. Deep heading, now in nearly 9,000 ft from the shaft, has not yet encountered any mineralization of commercial importance, he said.

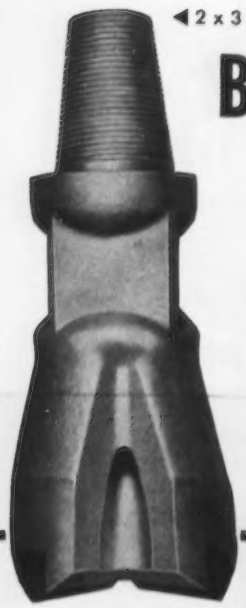
Lucky Friday Silver-Lead Mines Co. started operation of its new three-compartment shaft late in March and is now drawing plans for extending the deep bore another 400 ft to open two new levels at the 2450-ft and 2600-ft horizons in its Lucky Friday Mine east of Mullan. Ore zone has been lengthening steadily as depth has been gained, and on the 2300, the present bottom level, it has been opened for more than 1,200 ft with good grade stopable ore all the way and the east face still showing 2-ft of ore. Geological conditions promise continued improvement at lower levels Mine production is maintained at an average of about 125 tpd and it is stockpiled for periodic mill runs at the Golconda Lead Mines' custom concentrator. Such a mill run has been in progress since just before the first of the year, and by the end of March, 30 cars of lead concentrates and two cars of zinc concentrates had been shipped.

New west footwall lateral driven by New Rainbow Mining Co. at the old Weber Mine in Bonner County, near Lakeview, has opened an 18-in. width of silver ore assaying about 28 oz per ton, president R. B. Austin reported recently. Most encouraging feature of the development, he said, is the fact that it establishes the accuracy of old maps which indicated the presence of ore in this area and increases their value as a guide for further exploration. The heading is now being extended along the structure toward another "indicated" ore zone.

Six months' exploration work by Highland-Surprise Consolidated Mining Co. at the Deer Trail property in the Stanley basin of Custer County has developed 127,500 tons of zinc-lead ore, more than one-third as much as the company's Pine Creek mine in the Coeur d'Alene District produced in 45 years of operation. The reserves, estimated to a depth of 200 ft below the main adit level, are in five blocks ranging from 5½ to 18½% combined lead and zinc and they are near enough to the surface and close enough together to permit large-scale, low-cost stoping methods. Further exploration in an effort to develop additional reserves along the northerly and southerly extensions of the vein system is planned. Company officials believe that a minimum of 250,000 to 300,000 tons should be blocked out before a mill and camp construction program should be started.

Property of Sunshine Consolidated Inc. in the Silver Belt between Wallace and Kellogg, produced the highest grade silver-copper ore mined through the deep Sunshine Mining Co. workings during 1955. Mine output last year of 25,464 tons, the highest in the history of Sun Con, averaged 35.4 oz silver per ton. Production was from the 3400 and 3100 levels, and a deeper level, the 3700, is now being opened. Sun Con's earnings were up 10% last year to a record $126,889.

◀ 2 x 3 A. P. I. Threads



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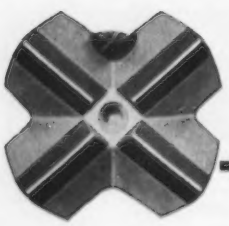

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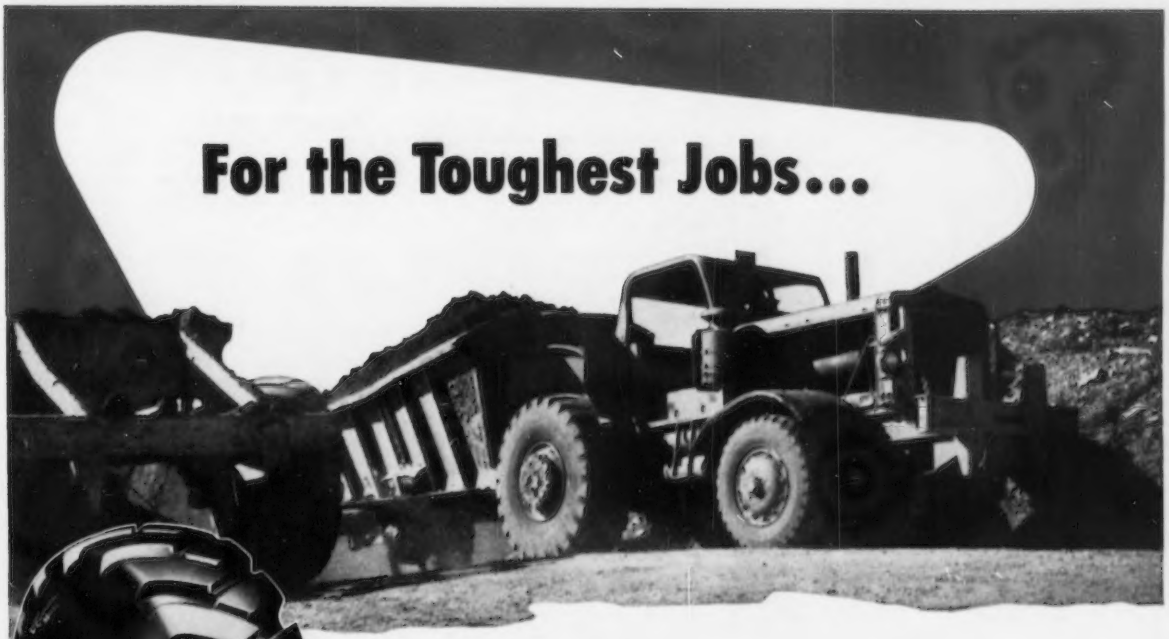

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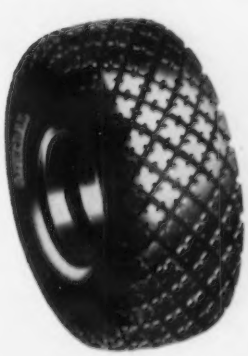

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MINNESOTA

At Reserve Mining Co's taconite plant, Silver Bay, the sixth pelletizing machine was put into operation during March. All of the pelletizing machines are now in operation, and the plant is ready to turn out taconite pellets in quantity. W. M. Kelley, president, pointed out that while the big construction program is now completed it will be some time before all isolated construction is completed and the operation is running at the full capacity of 3¾-million tons taconite pellets per year.

Rhude & Fryberger have started work on the addition of a new heavy-media section to their washing plant at the Troy mine, near Eveleth. The washing plant at the Troy mine was completed and put into operation during 1955.

At the Susquehanna mine, Hibbing, operated by Republic Steel Corp., a new tailings pond was completed during the winter months. Pond will be put into use during the 1956 ore season.

Agnew underground iron mine, Hibbing, operated by Cleveland-Cliffs Iron Co., shut down about the end of March 1956. The last iron ore was hoisted from the shaft and placed in stockpile on February 27, and since that date, all work has been the removal of underground equipment.

E. W. Coons Co. has completed a new cut to serve as a new approach to the Commodore open pit mine at Virginia, Minn. In 1955, the company shipped iron ore from the Commodore, Genoa-Sparta, Sidney, Bradford Annex, Chataco, Bradford, South Julia and Victoria mines.

Skubic Bros. Co., Virginia shipped 382,249 gross tons iron ore during 1955. Tonnage includes shipments from the Virginia mine plus ore from other mines and stockpiles in the area. Most of this tonnage was beneficiated at Skubic's Virginia mine concentrator. Currently, the Virginia concentrator is undergoing repairs and installation of new equipment for the coming season.

In 1954, 605,638 tons was shipped and by 1955 production was up to 758,406 tons at the West Hill mine of Western Mining Co. (Pickands, Mather & Co.) Development of its pit, located between Coleraine and Grand Rapids, began in December 1951. Plant construction started in the fall of 1952. Shipping began in July 1953 and 465,311 tons was produced that year.

West Hill ores are straight wash, and those requiring heavy-density and cyclone treatment. Crude ore runs from 35% to 48% iron. Plant is arranged to handle the different types of crude with a screening and crushing unit located in the pit, and washing, heavy-media and cyclone units on top. A 30-in. x 1040-ft. conveyor brings the ore to the surface. The plant has well exceeded its designated capacity of 700 tons per hour. Designed capacity of the heavy-media unit is 220 tons per hour and that of the cyclone unit, 160 tons per hour.

Republic Steel Corp shipped 1,437,810 tons of iron ore in 1955 from four properties on three iron ranges: Susquehanna and Stevenson on the Mesabi Range; the Tobin-Columbia-Monongahela group on the Menominee Range and the Penokee (from stockpile) on the Gogebic Range.

MICHIGAN

1955 was Gogebic County's best safety record for the 71 years since the Colby mine at Bessemer shipped the county's first iron ore. There were no fatal accidents and but eight which caused more than three months of lost time. During the year 2,884,475 tons of ore was shipped.

While Minnesota's iron ore reserves dropped from 1,218,586,648 tons in 1940 to 916,260,462 tons in 1954, Michigan's rose from 143,657,427 tons to 160,197,001 tons in that period. Most of the increased reserves come from the Marquette Range which gained nearly 20-million tons. The Menominee Range added about 2.4-million tons; but the Gogebic Range suffered a loss of 5,835,378 tons, leaving Michigan's net gain—not including low grade silicious ores—

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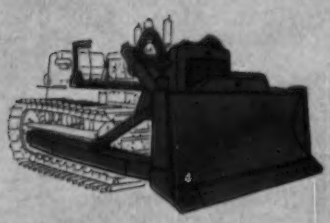

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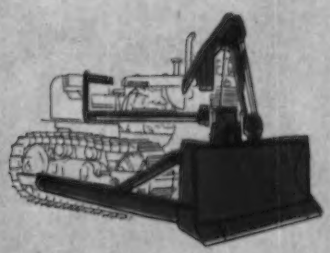
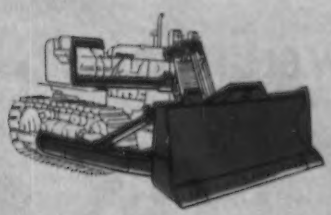


High-Gantry Cable Bulldozer
Operates off either front or rear-mounted International cable control unit. Available for TD-24, TD-18, and TD-14 tractors.



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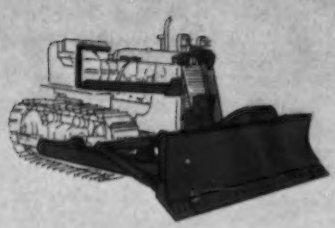

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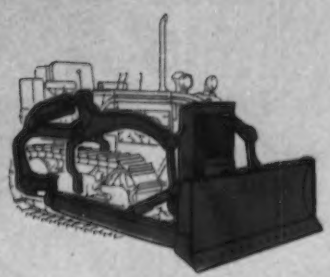
Operates off high or low gantry, front or rear cable controls on TD-24, TD-18, and TD-14 tractors. Hydraulic bullgrader also for TD-9, TD-6, and T-6 tractors.



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Michigan *(Continued)*

at 16,539,574 tons. Some new properties were developed on the Marquette Range during the last few years, particularly Jones & Laughlin Steel Corp's. new Tracy mine at Negaunee and Cleveland-Cliffs' stepped up development at the Mather, and Cliffs Shaft mines.

MONTANA

Anaconda Co. has announced an expanded mining and development program in Butte which will cost more than $35-million and add an additional 2,500 workers to the company payroll by the end of 1956.

Company officials said work will start soon on the Ryan shaft at a cost of more than $20-million, and another $7-million will be spent on the Berkeley pit and $9-million more for mill and smelter changes and railroad rolling stock as the organization continues its expansion program. (See Annual Reports, p 124.)

Latest Southern California Minerals Co., operation is a talc grinding mill at Barratts, now in operation by Tri-State Minerals Co., a wholly-owned division of SCMC. The mill installation was begun in the fall of 1955, was completed and began operation Jan. 24.

New grinding plant is of all concrete block construction, 200 ft long and 50 ft wide. Equipment comprises the latest type Raymond roll mill, capable of producing 40 to 50 cars of ground and processed talc per month.

NEVADA

Bristol Silver Mines Co. is producing 40 tpd of $70-$90 ore at Pioche from a new orebody developed at fissure junction on 500 level of the mine.

General manager John H. Buehler of Pioche and Midway, Utah, said ore had been opened on Werner lease to width of 60 ft; thickness of 30 ft and on vertical extension of a cut 78 ft.

Raising is in process.

Further development is needed for evaluation of the extent of the deposit, he said.

A recent shipment of smelting ore to Tooele, Utah, smelter of International Smelting & Refining Co. (Anaconda Co.) brought $4,201 for 55-ton railroad car.

O. C. M. Enterprises, headed by Jack Owens and Associates, of Moab, Utah, has leased a large block of mining ground in Fish Lake Valley from Wisdom & Mani, and are installing bunkers, slushers and other equipment preparatory to full scale operations scheduled to start this spring. An access road has already been completed, according to J. S. Wisdom, head of the owning firm.

A total of 44 tungsten mines employing nearly 1,000 men were producing ore or developing orebodies during March, according to figures reported from Washington. The Senate Interior and Insular Affairs committee was told that all of them are looking hopefully for Congressional action which will continue the Government's tungsten-buying program.

Index Daley Mines Co., of Salt Lake City, has started new tunneling operations at the Black Forest mine on Spruce Mountain, 44 miles southeast of Wells. George Rich, mining engineer of Mountain Home, Idaho, is in charge of the work, and says the ore contains lead and silver with an interesting showing of copper. Mine has been inactive for the last several years. The present work is by-passing extensive previous tunneling to drive a new tunnel—to 1,000 ft length —southwest and adjacent to Black Forest. Four men are at work on the project. Housing for men and equipment is also being built on the site.

Mining and milling of ore on a major scale was to start in April at the Constant Minerals Separation Process Inc. property 15 miles south of Reno. Maurice Constant, of Reno, is in charge of the development. Work carried on for the past months has uncovered a promising showing of lead-silver ore, which also contains some zinc, gold and tungsten. Arrangements have been made to have 400 tpd ore processed in a privately-owned custom mill.

First shipment of uranium ore from the Black Bonanza Co. property at Beatty was made in mid-March by trucks and the Union Pacific railway. The ore was

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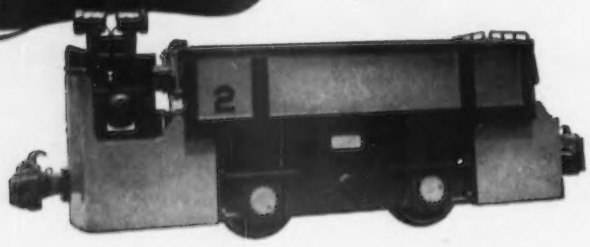

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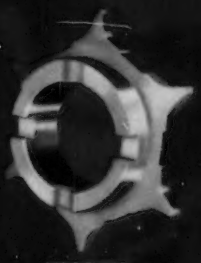


SPROCKETS

SHEAVE WHEELS & PINS

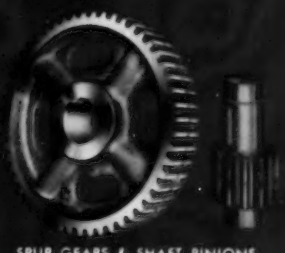
WALKING PINIONS

CAB ROLLERS

CAT DRIVE CLUTCHES

CONVEYOR ROLLERS

VERTICAL SWING GEARS



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There are thousands of "Tool Steel Process" products in hundreds of applications in the Mining Industry. They're guaranteed to deliver longer life in the same service than any other competitive product.

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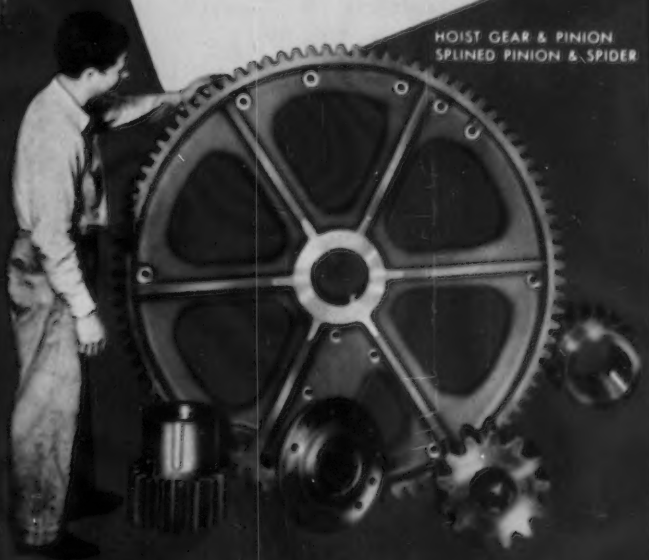

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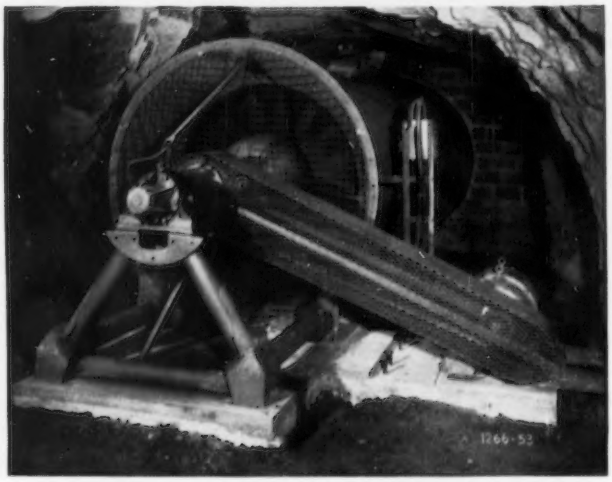
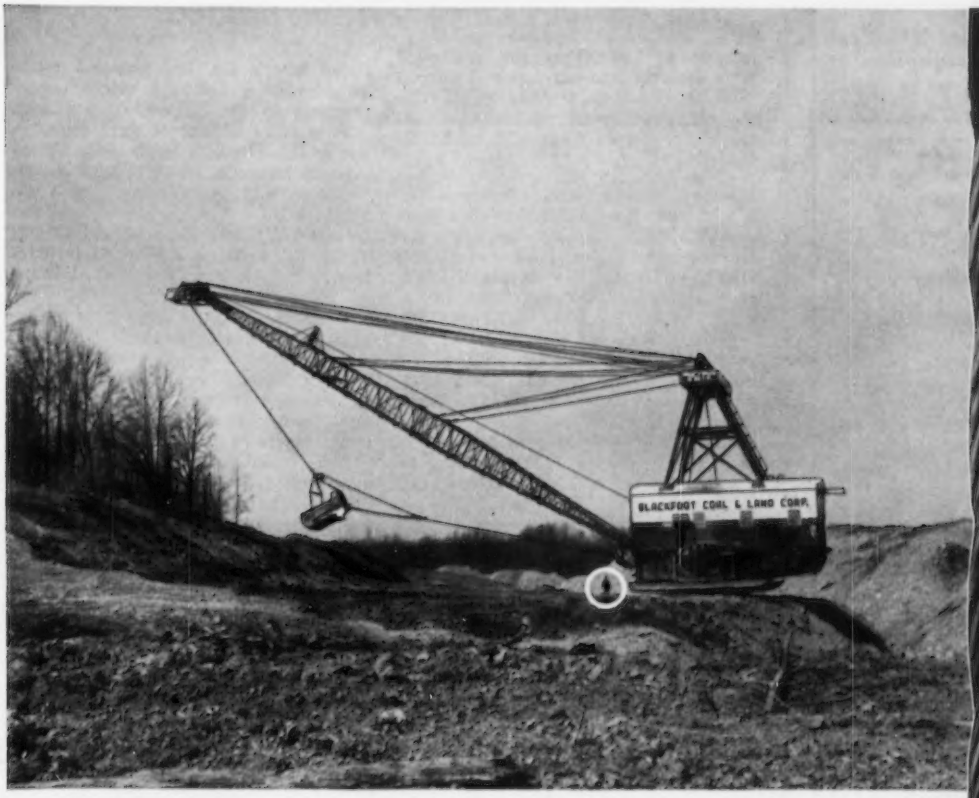
AERODYNE® Fan ventilating a South Dakota gold mine.



AERODYNE® Fan installed underground in an iron mine.

AERODYNE® Midget Blower serving a potash mine in the West.



50% Longer Life from VHS Dragline

. . . at Blackfoot Coal and Land

• Mr. Henry Fitch, Superintendent of Blackfoot Coal and Land Corporation, Oakland City, Ind., says: "The two ropes on our Bucyrus-Erie 500W Dragline normally lasted only from 1½ to 2 months—even though we used the best Improved Plow Steel lines we could get. We were pleasantly surprised when our first VHS line lasted over 3 months—an increase in service life of well over 50%. Naturally, we are using VHS from now on out."

New Grade of Steel

VHS is setting service records like this on draglines, shovel hoist ropes, and scraper cables all over the country. Made from a new grade of steel for wire rope, it is at least 15% stronger than IPS—the strongest grade formerly available. This means you can handle heavier loads with the same diameter line. And you get a higher factor of safety.

Cuts "Down Time"—Saves Money

New VHS is not only stronger, it is tougher, too. It resists abrasion . . . keeps its shape under pressure . . . can't become "hidebound" or lose its flexibility. It lasts longer in the toughest applications . . . such as draglines, shovel hoist ropes, and scraper cables.

The longer life you get with VHS saves you money. And you make more big savings by cutting "down time" of equipment for wire rope replacement.

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Your distributor has scraper cables, draglines, and shovel hoist ropes of new LAY-SET VHS in stock now. Just call him and tell him the size and diameter you want. You don't need any complicated specifications.

For more information see your Hazard distributor salesman or write to the nearest Hazard office for Bulletin DH-513H

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Nevada *(Continued)*

trucked to Las Vegas and stockpiled before loaded onto rail cars and shipped to the AEC processing plant at Salt Lake City. The shipment consisted of 20 tons and value ranged from 0.38 to 1.15% U_3O_8.

Holliday Mining Co., of Bremerton, Wash., has reported location of a large deposit of high grade uranium ore in the Gillis Range of the Hawthorne Mining District of Mineral County. AEC officials who visited the site confirmed the claim that ore assaying as high as 2% had been discovered in quantity. Underground development of the property has been going on for the last five months under direction of William B. Cline, and the work is being continued to further depths. Cline is working in conjunction with Ted and Oscar Johnson. Head of the Holliday Co. is Edward Goldberg, of Bremerton.

Trench-cutting operations at the Hercules Mines Co. property near Austin have revealed new orebodies. Bulldozers have been at work between the old Ophir and Union shafts in Pony Canyon despite cold weather and frozen ground, and diamond drilling has been resumed. Ore samples sent to Black & Deason at Salt Lake City are reported to have shown silver to the value of 900 oz, and the vein from which they were taken is one of considerable width.

NEW MEXICO

Foley Metals Co. has proposed establishment of a 1,000-tpd uranium concentrator in the Ambrosia Lake area.

Firm is an affiliate of three groups—Rio de Oro Uranium Mines, Inc.; United Western Minerals, which in turn is controlled by J. H. Whitney Co., New York, White, Weld & Co., New York and San Jacinto Oil Corp., Houston and Dallas, Texas, the Foley group which includes Foley Brothers, Inc., New York; Edward T. Foley, Pasadena, Calif.

Ore reserves would come from a sizeable deposit already blocked out by Rio de Oro now preparing to mine from a recently completed shaft and from United Western Minerals orebody. Other ores would come from new custom shippers in the district.

It is estimated that both Rio de Oro's and United Western's orebodies contain between 300,000 and 500,000 tons on basis of present proved and indicated drilling results.

The proposal was filed with the Grand Junction Operations Office of AEC.

In a far-reaching decision, U. S. District Judge Waldo H. Rogers of Albuquerque has ruled that railroads, and not the Federal Government, own oil and gas rights in lands granted under the Railroad Act of 1862.

Rogers had heard testimony and arguments in the case in Denver, Colo., and handed down his decision from his Albuquerque office.

Judge Rogers said his ruling "might be controlling" on uranium litigation now pending before him here in which two McKinley County ranchers, G. P. Roundy and Forrest H. Ives, seek mineral rights to patented land leased by the Santa Fe Railway to the Sabre Uranium Corp. and Piñon Uranium Co.

The land in question was included in a great many tracts granted to the two railroads to encourage their westward expansion in 1862.

Standard Uranium Corp. of Moab and Col-U-Mex Uranium are entering into a joint venture for drilling nearly 2,000 acres in the Ambrosia Lake area, president William R. McCormick of Standard has disclosed.

Drilling is expected to start this summer, he said.

McCormick early in April was named vice president of Utex Exploration Co., replacing W. T. Hudson. Hudson, an early associate of Charles A. Steen, recently sold his interest in Utex for a reported $500,000.

NORTH CAROLINA

Dr. J. L. Stuckey, North Carolina state geologist, said April 12 that the Kings Mountain area has become "the hottest spot in America" in the mining of spodumene and that "on the basis of interest in spodumene, it offers more potentialities than any other mineral in North Carolina.

Mineral Resources Committee of the

Electric Smelting Furnaces

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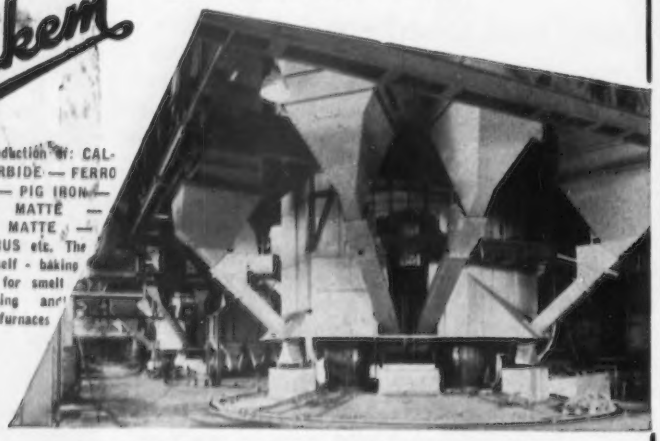

Furnace Platform of three 33,000 KVA Elkem Pig Iron Furnaces (Type Tyaland—Hole) at Mo i Rana, Norway

In existence for over 50 years, Elektrokemisk has served as consultants and constructors of smelting plants and aluminum reduction cells.

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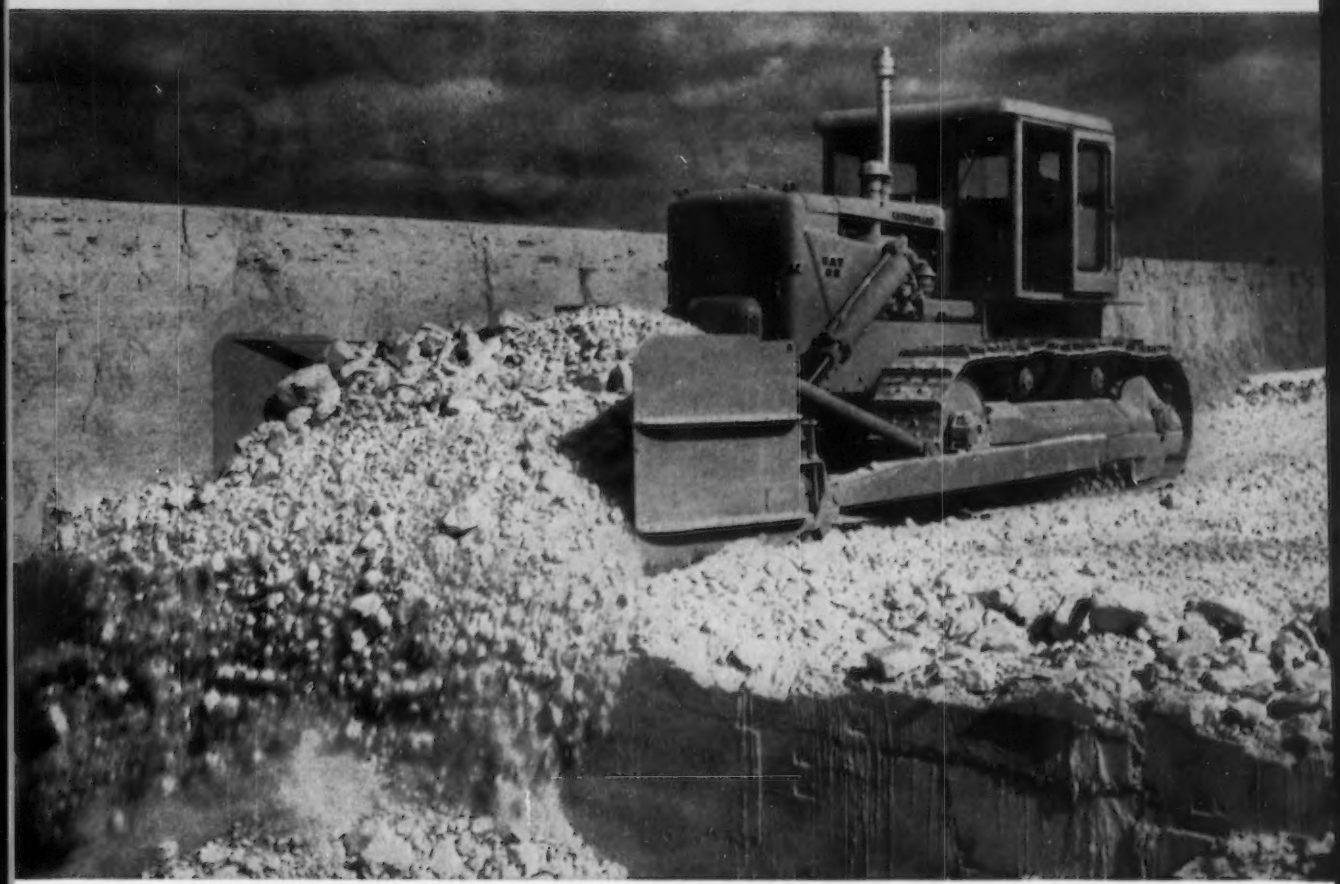
HOW A NEW IDEA AND A NEW **D8**
CUT MATERIALS-HANDLING COSTS



This new CAT* D8 Tractor is hard at work in one of the sulphur vats in the Texas-Louisiana Gulf Coast Area. Note the special sideboards and extended blade on the No. 8U Bulldozer, which also has back-rip teeth. This rig breaks down vats of sulphur and handles in excess of 400 tons per hour of the light material.

The new D8 handles sulphur more quickly and inexpensively than was possible with the old method of blasting. In addition to saving several hundred cases per month of blasting material and eliminating other expensive related operations, the new Caterpillar D8 Tractor with 'dozer breaks up sulphur lumps and does away with hand picking.

Why was Caterpillar selected? First, because of the close co-operation of the local Caterpillar Dealer in developing this special sulphur-handling 'dozer. Second, because of the excellent performance of other equipment built by Caterpillar, which is used almost exclusively by this producer.

The new Caterpillar D8 Tractor is designed to outwork and outlast any previous crawler. Its new 4-cycle Caterpillar Diesel Engine develops 191 HP. New seven-roller track frame and "water-quench" hardened track shoes give even longer work life. Hydraulically boosted steering, "in-seat" starting and superb visibility give the operator greater efficiency and convenience. The D8 is available with torque converter (Series D) or exclusive oil clutch (Series E) to suit *your* job.

See your Caterpillar Dealer for full details. And count on him for dependable parts and service.

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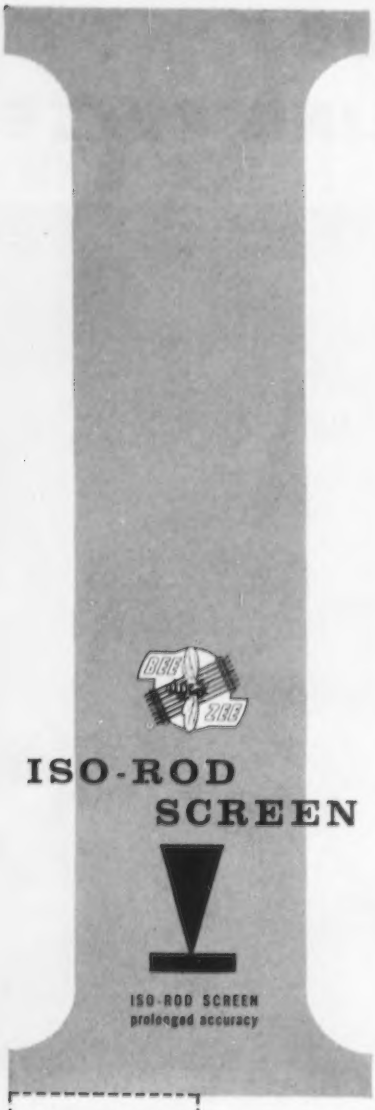

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North Carolina *(Continued)*

North Carolina State Board of Conservation and Development reported at a meeting at Rocky Mount April 9 that field work has been set up for a survey report on spodumene resources in the Kings Mountain area.

It said explorations for tungsten in the Mount Pleasant area of Cabarrus County are under way, and that a program has been set up to prepare a new geologic map of the state at a cost of $35,000.

Lincoln Lithium Co. has been formed and is seeking options from property owners in the Maiden area.

Walter Clark, one of the incorporators of the firm, said that a total of 2000 acres in Lincoln and Catawba Counties already had been leased as of March 28. The Catawba County area under study is just south of Maiden, on the Lincolnton Road, extending northeast to Olivers Crossroads.

OREGON

Hanna Coal & Ore Corp's nickel development at Riddle moved into final stages in April when the fourth and final furnace for production of ferronickel was to be placed in operation. Hanna put the third furnace in service Feb. 1.

"Mine production has, of course, been stepped up to meet the additional ore demand," reports Earl S. Mollard, general manager for Oregon operations, but the size of the smelter and mining crew, while increased, has not been increased proportionally to the 30% increase in output resulting from addition of the final furnace operation.

Hanna's smelter crew comprises about 425 men and the mining crew 50 to 60.

Hanna is reluctant to discuss its project, the nation's primary source of ferronickel built under defense stockpiling purchase contract stimulant and given high percentage fast amortization benefits, but Oregon Department of Geology and Mineral Industries' data indicate in 1955 the mine produced 390,000 tons of ore from which the two furnaces then in production turned out 15.2-million lb ferronickel. This can be further refined to 6-million lb nickel. The company also produces considerable quantities of ferrosilicon which it uses in its operation.

UTAH

Survey to determine surface rights on mining claims in the North Elk Ridge area of the Manti-La Sal national forest was started by the U. S. Forest Service in April. Survey is being made in accordance with the new multiple-use mining law signed last July 23. Forest Service officials said owners of claims located prior to that date will be given ample time to assert surface rights, if they so desire.

A Moab uranium stock company in April was hand-sorting ore from a high-grade seam in hope the firm might be the first to claim the long-outstanding AEC bonus of $10,000 for delivery of the first four tons of ore averaging over 20% uranium oxide.

The seam was found in the Allen No. 2 mine in Red Canyon, San Juan County, operated by Utaco Uranium, Inc., under lease from Lakeside Monarch Mining Co. Initial assay showed 81.183% U_3O_8, and about two tons had been sacked by April 7.

Ute Milling Co. has filed a proposal for establishment of a multi-million dollar uranium concentrator at north end of the Big Indian District, San Juan County.

The proposal filed with Atomic Energy Commission's Grand Junction Operations Office is by an affiliate of Hidden Splendor Mining Co., wholly owned subsidiary of Floyd B. Odlum's Atlas Corp.

Those who have knowledge of the document report that Homestake Mining Co. is listed also as having a minority financial interest in Ute Milling Co.

Homestake has two mines, operated by affiliates, in the Big Indian District.

Full participation by Homestake in the milling venture possibly may await nature of final contract approved by the Commission, observers cautioned, however.

Homestake earlier had agreed to sign contracts with Odlum, committing output of its Big Indian mines to the Atlas Corp.-sponsored milling venture.

Pattern now established is this: Hidden Splendor will do the mining. Ute Milling will own the mill. A management group will operate the mill on a fee basis.

The mill will reportedly employ new wrinkles in carbonate leaching of high lime uranium ores of the Big Indian District.

Already in the Odlum camp are the following reserves: Radon mine; Lisbon orebodies; Cal-Uranium Mine; Almar Minerals orebody (Daniel-Ruddock orebody). Homestake has La Sal, Little Beaver and is sinking shaft on Alice orebody in development of a mine.

Only uncommitted major reserve: Cord Group of claims owned by E. L. Cord interests of Los Angeles and Reno, Nev.

Other orebodies in district are "controlled" by Uranium Reduction Co. and Charles A. Steen associated interests.

U-Neva Uranium Corp, headed by Salt Lake banker Walter E. Cosgriff, reports discovery of high grade asphaltic uranium ore outcrops in Birdseye area of San Rafael Swell, Emery County.

M. S. Crawford, firm geologist, says that representative samples run 0.45 U_3O_8. He cautions, however, that considerably more exploration and development work will be required before the commercial nature of the discovery can be ascertained.

New Park Mining Co. has finally encountered bedded lead-silver-zinc ore at east portion of its Park City mine, W. H H. Cranmer, president, reports.

He says the orebody is "extensive," Initial bedding was discovered for first time in history in lime layer between shales in New Park mine on 1600 level last

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"BLUE RIBBON" PRODUCT

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They can be used as blowers or exhausters and are driven either by compressed air or electric motor, with capacities up to 90,000 CFM. Like all Coppus products, these blowers wear the "Blue Ribbon" that stands for high achievement in engineering, workmanship and performance.

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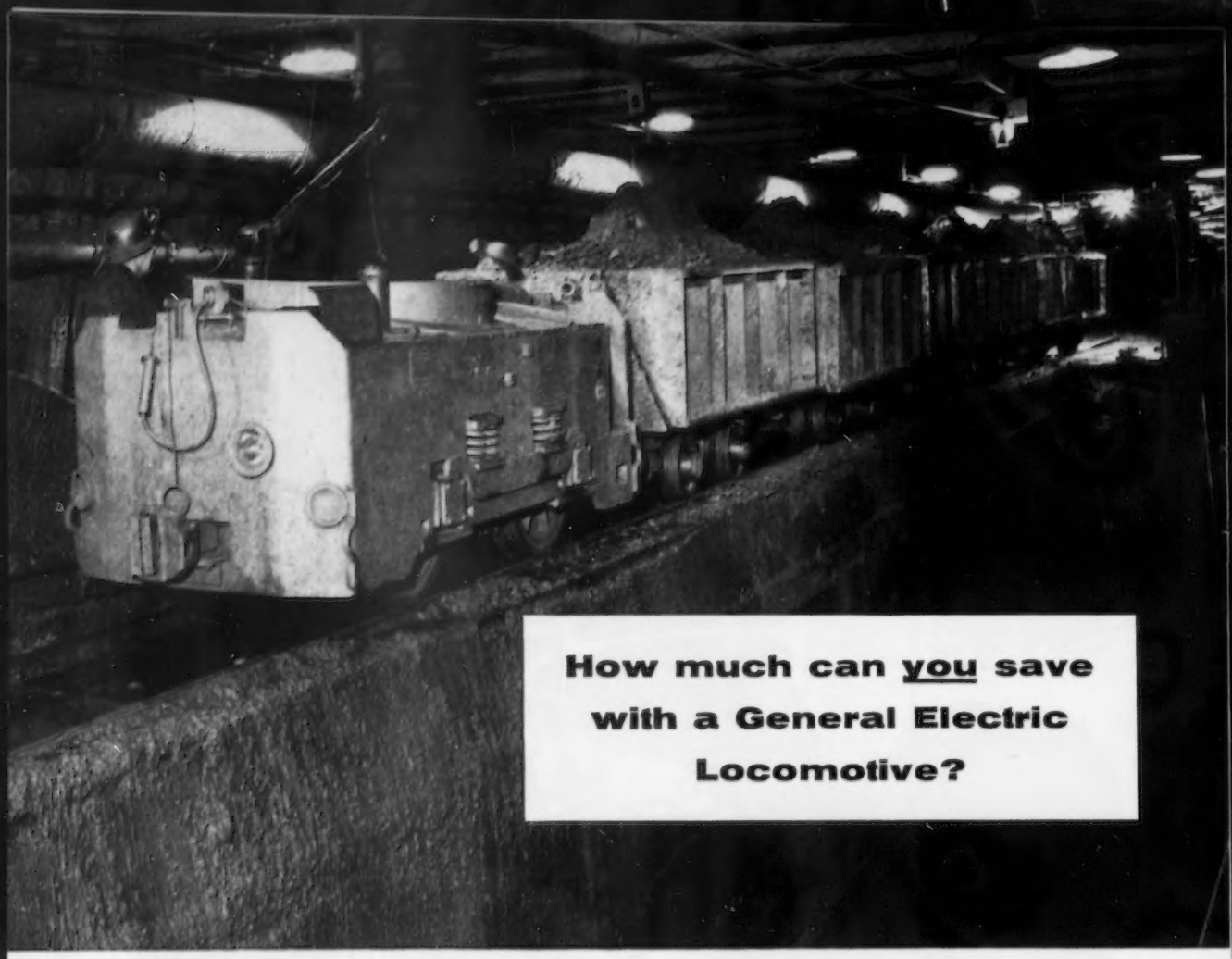

Cost Saving G-E Locomotives Will Haul a Planned 4000 Gross-tons of Iron Ore a Day for Jones & Laughlin Steel Corp.

Four G-E 6-ton electric mine locomotives are giving Jones & Laughlin Steel Corp. top performance under the toughest conditions at J & L's Tracy Mine in Negaunee, Michigan. These locomotives operate almost continuously 850 to 2500 feet below surface under extremely wet conditions. That's hard on any machine!

The 6-ton cable reel electric mine locomotives offer many advantages. Three of their leading features are:

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2. SAFETY—Centrally balanced, these locomotives are designed to prevent costly derailments. Sealed motors provide maximum flash protection.

3. LOW COST—Power consumption is low because of highly efficient traction motors. Parts needing attention are quickly and easily accessible. And, the smooth ride afforded by equalized spring suspension means less track pounding and rail climbing—less track maintenance.

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120-83

GENERAL ELECTRIC

Utah *(Continued)*

year. The downward extension appears to be broadening satisfactorily. Miners are now raising and continuing drifting.

Rapid expansion of production of the Spook-Dee mine and adjacent Bullseye uranium claims in White Canyon District, San Juan County, is promised by Cog Minerals, Inc., affiliate of Colorado Oil & Gas Co.

Cog Minerals recently acquired Midwest Consolidated Uranium Corp., former owners of Spook-Dee, producing 30 tons of uranium ore daily, and holder of lease on the Bullseye.

Other principal properties of Midwest were the Eureka-Buckhorn mine on Paradox Anticline near Montrose, Colo.

In all, Midwest had six operating mines producing more than 1,000 tons of 0.36 U_3O_8 grade uranium ore on the Colorado Plateau.

Uranium King Corp. is shipping uranium ore from its Cove, White Canyon District, mines at rate of $12,500 (gross) monthly, president of firm reports. Firm recently signed a DMEA contract for 500 ft of drifting and 1,000 ft of longhole drilling on the deposit.

Comstock Chrome and Tungsten Co., Salt Lake City, reports production of 20 tpd chrome concentrates from its renovated mill at John Day, Ore. Shipments are to Grants Pass buying station of U. S. Bureau of Mines. C. G. Cafarelli, president, said the shipments represent a gross value of $1,000 daily.

Utex Exploration Co. has obtained what probably are the first uranium lode patents ever issued by the U. S. Government.

Raymond T. Senior of the firm of Senior & Senior, Salt Lake City, states the patents cover Charlie Steen's Mi Vida mine and nine other claims.

Converted to fee simple, private property are 220.74 acres. The claims taken to patent were: Mi Vida, Mujer, Sin Verguenca, Mi Corazon, Mi Amorcita, Mi Alma, Barcardi, Pisco, Te Quiero, Linda Mujer, Fundalora, Besame Mucho.

Clayton Silver Mines, Kellogg, Idaho, has joined with Sunshine Consolidated, Inc. and Silver Syndicate in a joint exploratory venture outside the Coeur d'Alene district.

One result of the new program of diversification, undertaken because of dwindling receipts from the Idaho properties, has been acquisition of a 20% royalty right with Sunshine Mining Co. and Uranium Discovery and Development Co. in the Ransom uranium mine near Blanding.

Shareholders of Apache Uranium Corp. have approved merger into and with International Oil & Metals Corp., Spokane, Wash. concern headed by H. B. Haffner, retired general manager of Bunker Hill & Sullivan Concentrating & Mining Co.

Some 30 shares of Apache, headed by Geologist Stanford R. Mahoney of Salt Lake City, would be exchanged for one of International.

Standard Uranium Corp. reported that

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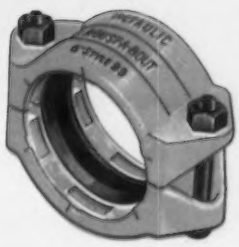

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For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 8".

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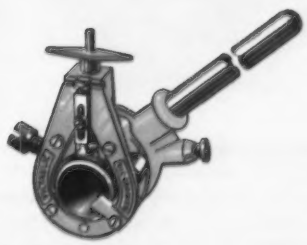

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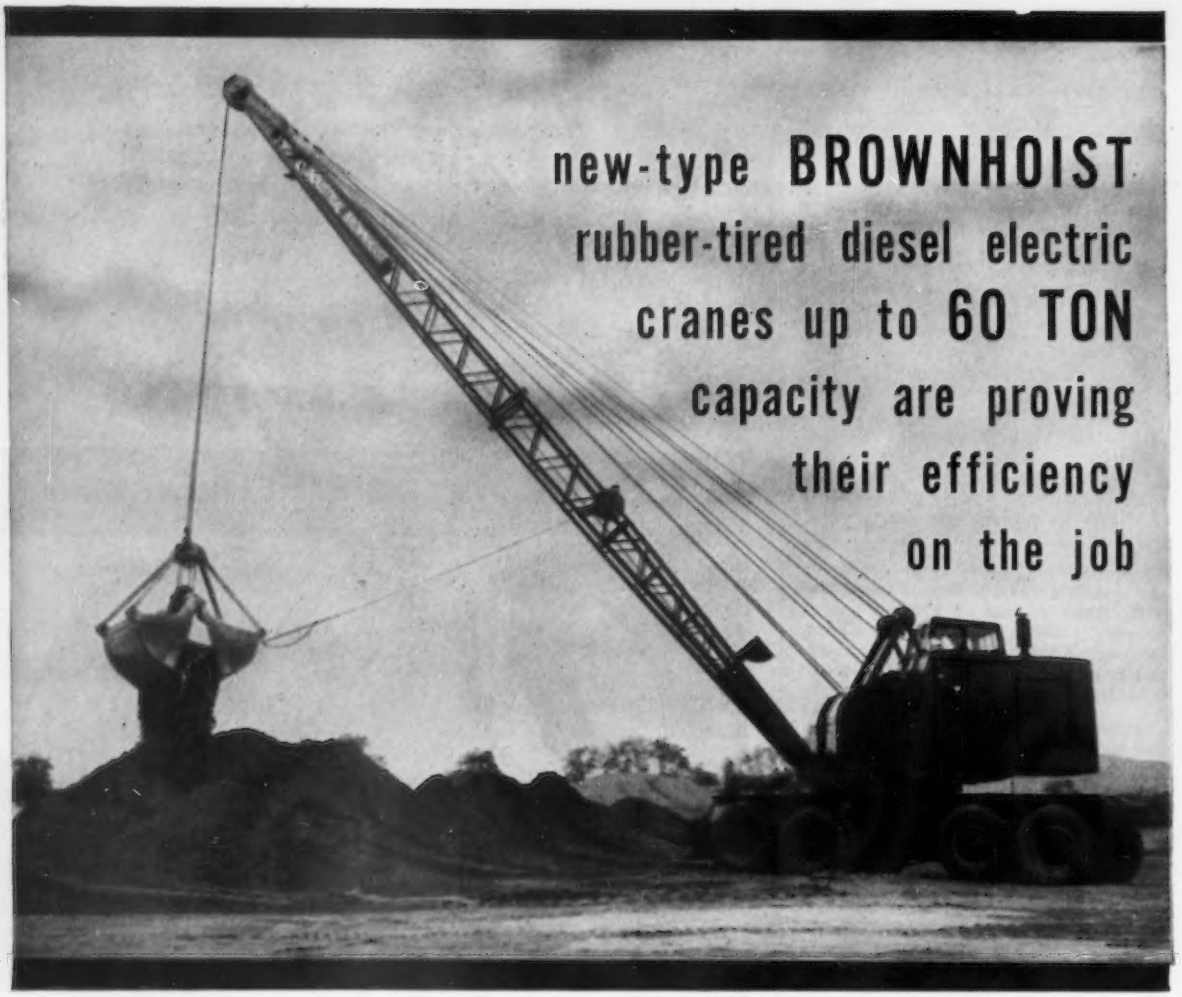

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BROWNHOIST MATERIAL HANDLING EQUIPMENT GIVES A LIFT TO AMERICAN INDUSTRY

The new Brownhoist Wagon-Cranes are specifically designed to do an outstanding job wherever high mobility and high capacity are required. You'll see them at work performing heavy duty jobs in mines, quarries, steel mills, for railroad and lumber operations and for many other large industries. Equipped with dynamatic clutch, anti-friction bearings at all essential points, power steering, electric travel and electric rotation. Mounted on a 12 wheel crane carrier capable of speeds up to 8 miles per hour, the unit can be operated by one man from easy-to-reach controls. Economical to operate. Available in capacities from 25 to 60 tons. For specification folder or further details, get in touch with our nearest representative or write us at Bay City.

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BROWNHOIST

Utah *(Continued)*

lime penalties on ore shipped last year exceeded receipts from vanadium payments by $145,942.

W. R. McCormick, Moab, president, told shareholders in annual report that the penalties amounted to $456,298.

Standard reports net profits of $588,521 after taxes but before depletion in 1955.

Ore reserves of its Big Indian mine are placed at 513,740 proved and probable.

The firm also reported for first time that its "joint venture" with Uranium Reduction Co. on the Mamie claim in Big Indian District had turned up to date some 109,297 tons in one orebody.

Mining costs, initially estimated as the firm entered operational stage in early 1955 at $12 a ton, were actually only $7.029 a ton.

WASHINGTON

Daybreak Uranium, Inc., proposes an extension of its shipping contract with Vitro Uranium Co., Salt Lake, that would boost shipments to a maximum of 2,000 tons monthly. Present contract expired April 30, provided for shipment of 400 to 900 tons of ore a month.

Under the proposed extended contract, Daybreak could ship up to 40 carloads monthly. Through February, the firm had shipped 88 carloads, including 800 tons of ore in February. The proposed contract extension would run through 1956.

Daybreak also is expanding exploration on the Spokane Indian Reservation. To date, all shipments have been from properties in the Mount Spokane district.

Daybreak president James W. Fox says the company expects to gross up to $5,000 a month from its leaching operation at the Calaveras copper mine in northern Calif., near Copperopolis.

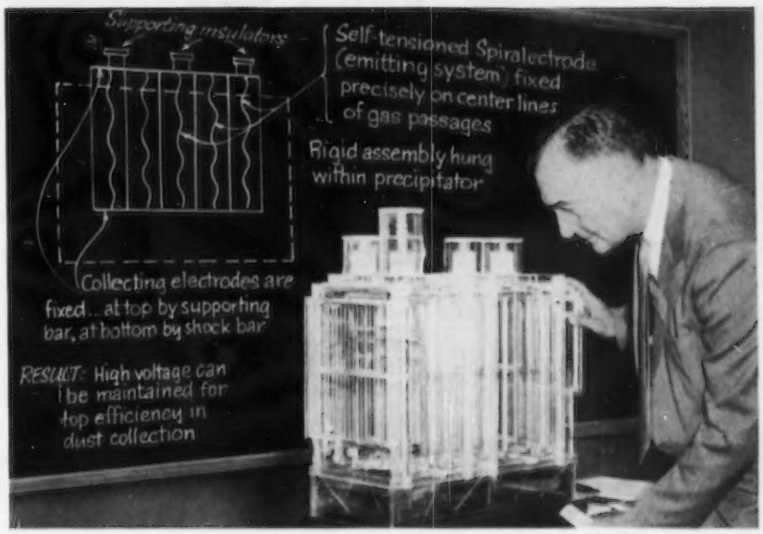
The operation has produced three carloads of 15% copper, now ready for shipment. Fox estimates the value at about $6,000 per car. Daybreak, under an operating agreement, is recovering copper from water pumped from the old mine and from dump material. Water is expected to produce 45% copper concentrate.

Crystal City Mining Co. plans to develop a pioneer lead, silver and tungsten deposit in Lincoln County, about 24 miles north of Davenport, the county seat. The properties consist of about 50 acres originally located in 1895. Before World War I these were developed by the New Crystal Mining Co.

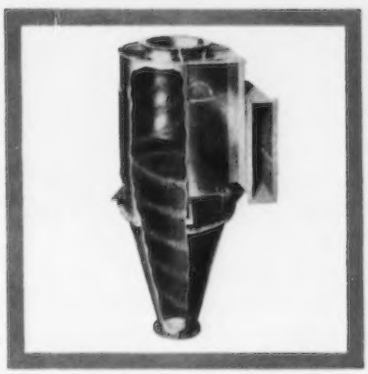
The second uranium lease on the Spokane Indian Reservation has been granted to Big Smoke Uranium Inc., for 160 acres. Big Smoke has been exploring a uraninite deposit in the reservation but was delayed in developing the property by bad weather. Work resumed early in March.

Big Smoke lease allows development of the discovery on a royalty basis for a period of 10 years, and for as long after that as ore is produced in commercial quantities. Spokane Indian tribe granted its first mining lease approximately 18

How fixed electrodes assure top efficiency in a Buell "SF" Precipitator


Supporting insulators
Self-tensioned Spiralectrode (emitting system) fixed precisely on center lines of gas passages
Rigid assembly hung within precipitator
Collecting electrodes are fixed... at top by supporting bar, at bottom by shock bar
RESULT: High voltage can be maintained for top efficiency in dust collection

PHOTOGRAPH OF BUELL PLASTIC MODEL BY INDUSTRY & POWER



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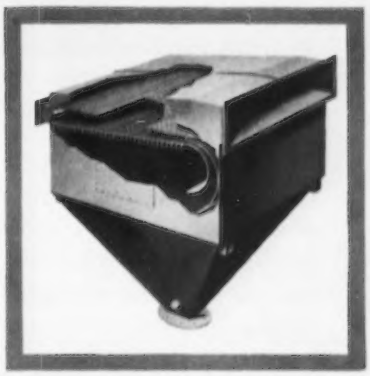

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Washington *(Continued)*

months earlier to Midnite Mines, Inc., which developed the first uranium discovery on tribal lands.

Kenneth V. Russell, Big Smoke geologist, said crews are bulldozing and stockpiling to prepare for shipments. Additional drilling is scheduled when weather allows.

Big Smoke also announced location of silica on the Spokane Indian Reservation, and has signed a 15-year lease on 120 acres of allotted land owned by Mrs. Lucy O. Bigsmoke. Silica deposit is about 4 miles southeast of the Midnite Mine.

The firm is negotiating sales contracts to permit open-pit mining. An outcropping of the deposit contains more than 100,000 tons assaying 99.39 to 99.83% silica.

Dawn Uranium & Oil Co. has accepted the offer of Vitro Uranium Corp., Salt Lake, to buy ore produced at Target Uranium Co.'s Smith lease in the Mount Spokane district. Details of the contract have not been worked out.

The agreement takes effect when Dawn concludes an initial 200-ton shipping contract with the AEC. Dawn has 1,000 tons of ore stockpiled but cannot haul it to a railhead until springtime road limits are lifted by Spokane County engineers.

Vitro previously agreed to buy ore produced in the Mount Spokane district by Daybreak Uranium, Inc.

Copper-gold-zinc ore produced by Howe Sound Co. at Holden, in 1955 was higher grade than ore mined in the preceding two years, according to the company's annual report.

Production in the Chelan division continued at a normal rate, and a long tunnel, driven to undercut surface mineralization containing copper and nickel values, was advanced 2,489 ft. The tunnel has reached its primary objective in previously unexplored deposits but will be continued.

Results of the tunnel investigation were negative up to the end of last year but final evaluation must await further diamond drilling.

Ore reserves in the Holden property decreased during 1955, and the company plans accelerated exploration during 1956.

Uranium prospecting will be prohibited in Washington state parks — including Mount Spokane state park—until after the 1957 legislative session. The state parks commission and department of public lands announced they have decided to withhold prospecting permits on park or school lands to preserve the land surface.

The agencies said they have received more than 500 applications for prospecting permits.

The decision said, "The state agencies feel that the present state laws are not adequate for the issuance of prospecting leases in these park areas. . . . It has been agreed to hold off the issuance of any leases until remedial legislation has been obtained."

A number of mining leases have been filed on private and state property not in

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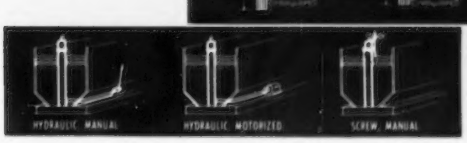

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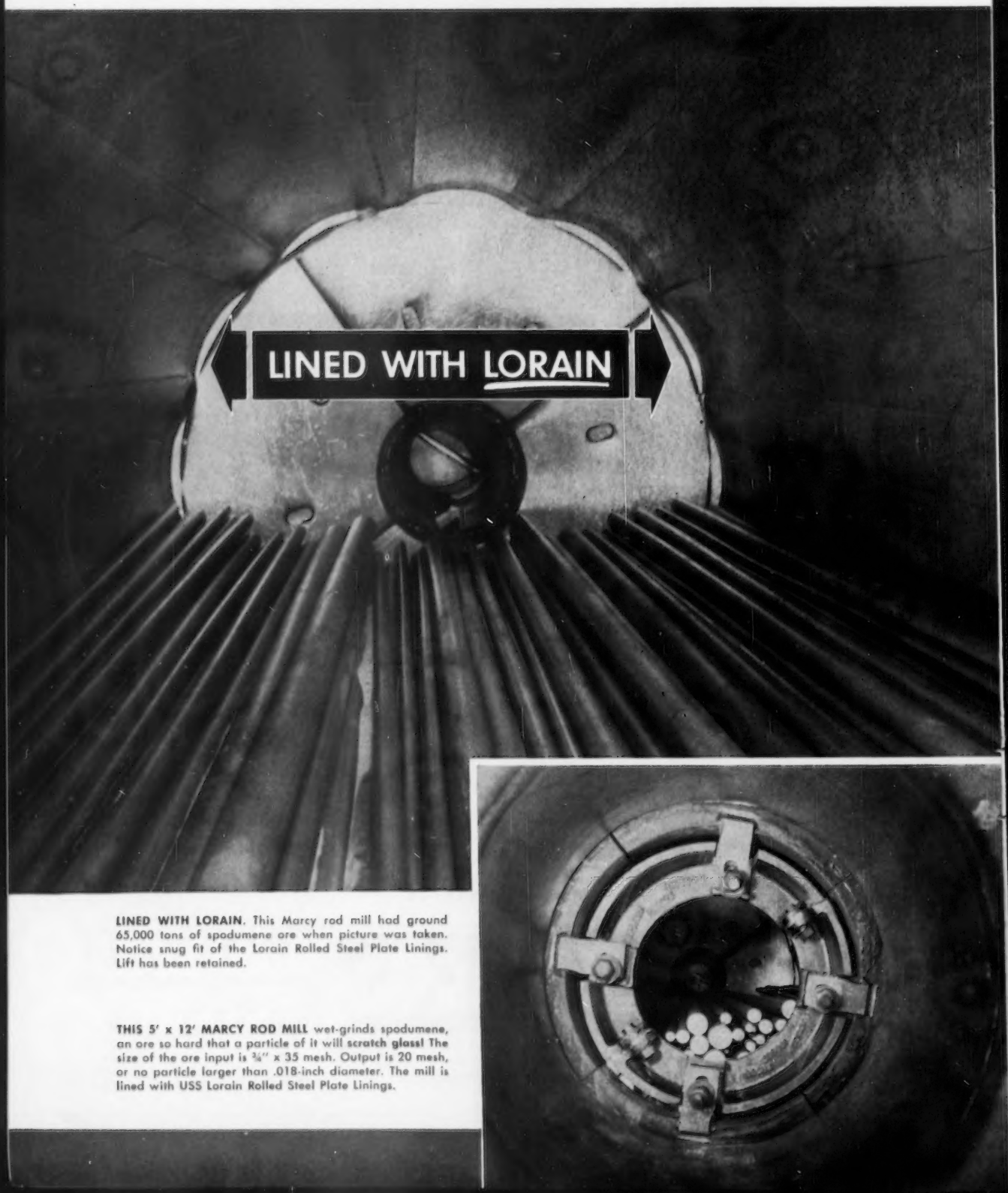
Foote Mineral grinds



LINED WITH LORAIN. This Marcy rod mill had ground 65,000 tons of spodumene ore when picture was taken. Notice snug fit of the Lorain Rolled Steel Plate Linings. Lift has been retained.

THIS 5' x 12' MARCY ROD MILL wet-grinds spodumene, an ore so hard that a particle of it will **scratch glass!** The size of the ore input is ¾" x 35 mesh. Output is 20 mesh, or no particle larger than .018-inch diameter. The mill is lined with USS Lorain Rolled Steel Plate Linings.

hard spodumene ore...

with USS Lorain Rolled Plate Linings

Spodumene makes for tough grinding. In fact, a small particle of it is sharp enough to scratch glass—a feat usually reserved for diamonds. Spodumene-bearing pegmatite is a source of lithium, an element used in the manufacture of glass, ceramics, and greases. This hard ore can—and has—played hob with grinding-mill linings.

When Foote Mineral Company, King's Mt., N. C., put two 5′ x 12′ Marcy rod mills to work wet-grinding spodumene in 1953, USS Lorain Rolled Steel Plate Linings were used in one of the two mills. After ten months, the Lorain Linings had ground a record tonnage of spodumene and lasted 33% longer than the linings in the other rod mill.

An engineer at Foote Mineral Co. said: "Lorain liner costs have averaged substantially less per ton of ore ground than our former liners. We are particularly pleased with Lorain Liners in that, after installation, we experienced no liner shifting or bolt breakage."

USS Lorain Plate Linings give this kind of performance because the steel is rolled to specifications that result in toughness, which allows the liner plates to wear paper-thin without failure.The lift bars are rolled from alloy steel for *extra* hardness that maintains lift and grinding efficiency for the life of the lining. Because Lorain Linings are tougher, thinner linings can be used—thus increasing mill capacities.

For close tolerances and snug fit, for long-lasting linings that mean lower-cost grinding, always specify USS Lorain Rolled Plate Linings. A note to Specialty Products Sales, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa., will bring experienced engineering assistance on any grinding problem.

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USS LORAIN ROLLED PLATE LININGS *and* USS GRINDING BALLS

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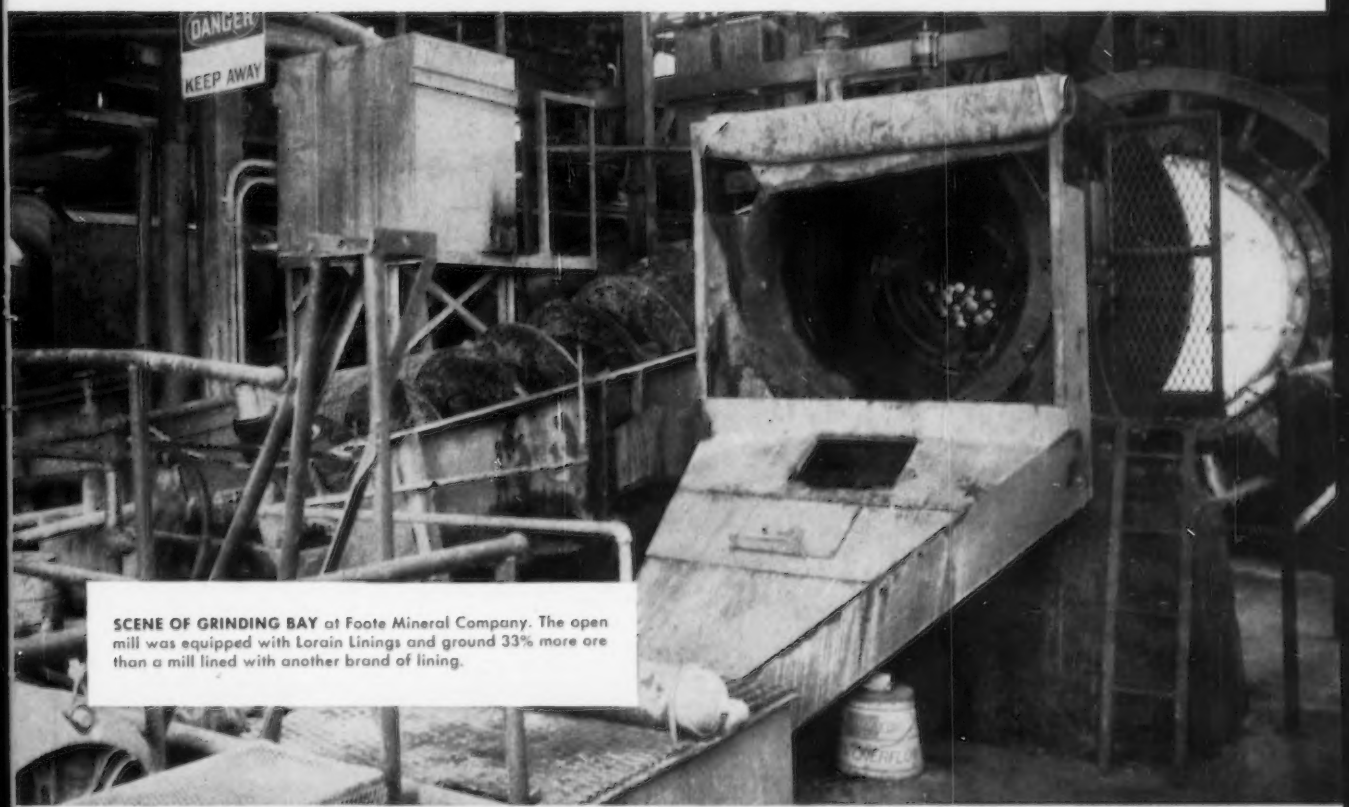
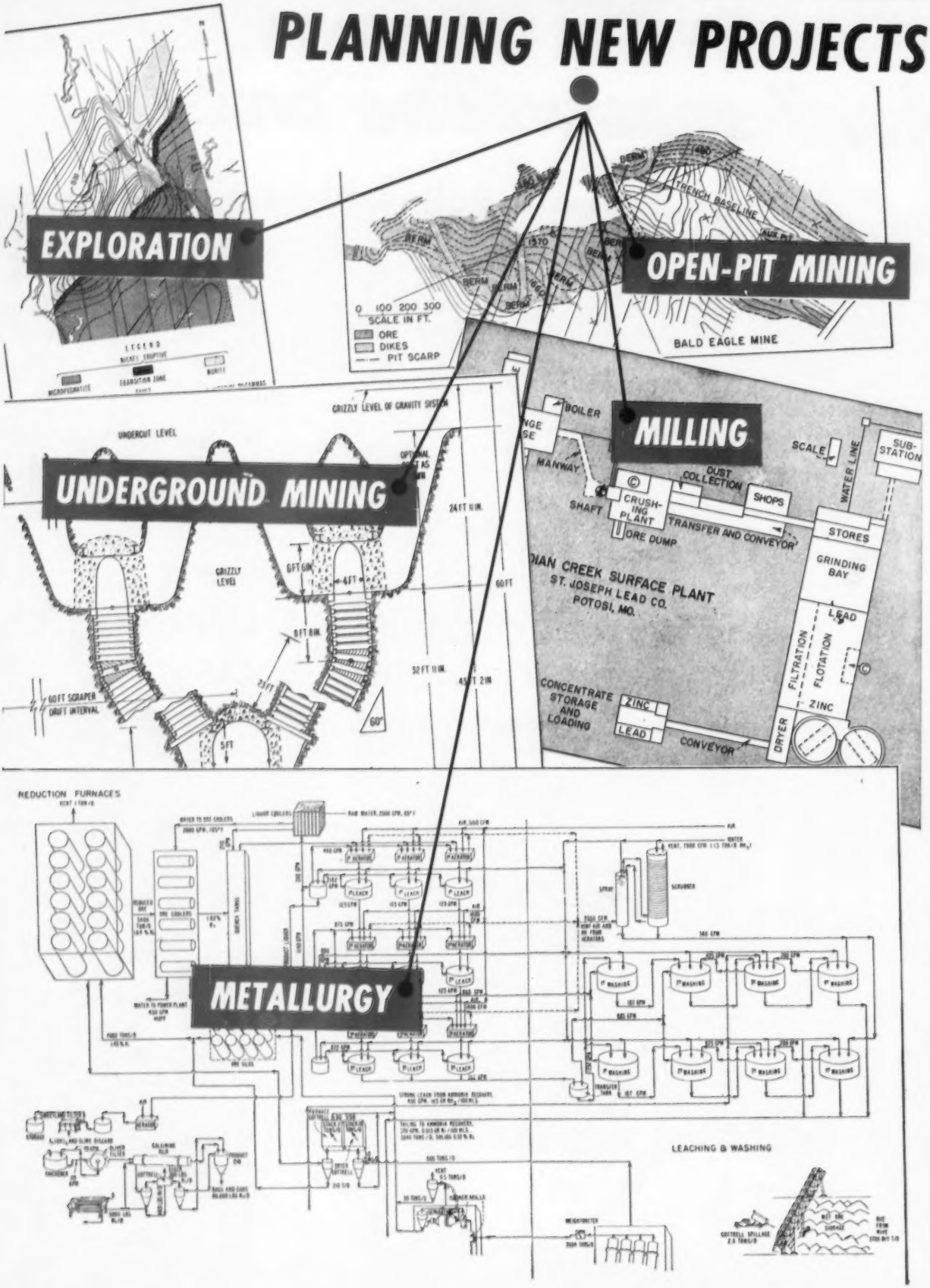


SCENE OF GRINDING BAY at Foote Mineral Company. The open mill was equipped with Lorain Linings and ground 33% more ore than a mill lined with another brand of lining.

UNITED STATES STEEL

PLANNING NEW PROJECTS



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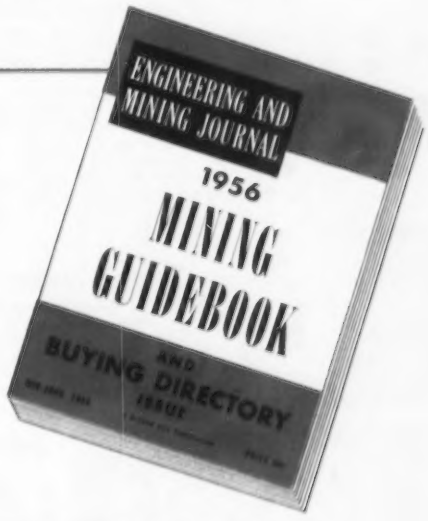

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Washington *(Continued)*

the park system in the Mount Spokane district, and the Daybreak Uranium Corp.'s producing uranium property lies near the Mount Spokane park boundaries.

WYOMING

Teton Exploration Drilling Co., Riverton, has shipped two loads of uranium ore from its new claims in the Pryor Mountain area near the Wyoming-Montana border.

The shipment was Teton's first from its 28 claims in the newly-discovered uranium area.

Two-States Uranium Co. has switched from open pit to underground mining. A blast of 14,000 lb of dynamite loosened 40,000 cu yd of overburden to expose an estimated 10,000 tons of uranium ore. The pit is more than 100 ft deep.

"The Future of Atomic Energy" was the featured address at the first annual convention of the newly-formed Wyoming Mining Assn. April 20-21 in Riverton.

Speech was delivered by Eugene B. Hotchkiss, vice president of Vitro Corp. of America, New York City. Another speaker was Solicitor J. Reuel Armstrong, U. S. Interior Dept.

Warren Oil & Uranium Corp. Fort Worth, Tex., is reported to be planning to begin mining tungsten soon in the Copper Mountain area of Fremont County.

The ore would be transported to the modern flotation mill at the Pioneer-Carrisa gold mine near South Pass City. Warren has leased mill facilities.

The firm has started pilot mining operations at the old tungsten mines on Hoodoo Creek in the Owl Creek Mountains northeast of Shoshoni.

The rated capacity of the Carrisa mill is 100 tpd, but the firm has indicated it does not intend to operate full speed.

Uranium ore shipments to the AEC buying station at Riverton in March approached an all-time record. Shipments totaled 85% of the January record, excluding a large shipment of Lucky Mc ore stockpiled to dry.

Vitro Minerals Corp. was largest shipper with 3,500 tons, their quota. Three other firms met their quotas: Globe Mining Co., Valley Dean Corp. and Two-States Uranium Co.

Atomic Energy Commission is reported to be considering approval of two smaller uranium processing mills in central Wyoming to serve the area's best producers at Crooks Gap and Gas Hills in Fremont County.

Sen. Joseph C. O'Mahoney (D-Wyo.) said the AEC told him the ore reserve picture, size of area, and new developments indicate the two producing areas could be better served by separate mills.

Lost Creek Oil and Uranium Co., Rawlins, had submitted a proposal to the AEC to erect a $2-million mill in Riverton capable of processing 200 tpd ore.

Lucky Mc Uranium Corp. and Utah Construction Co. have proposed to build

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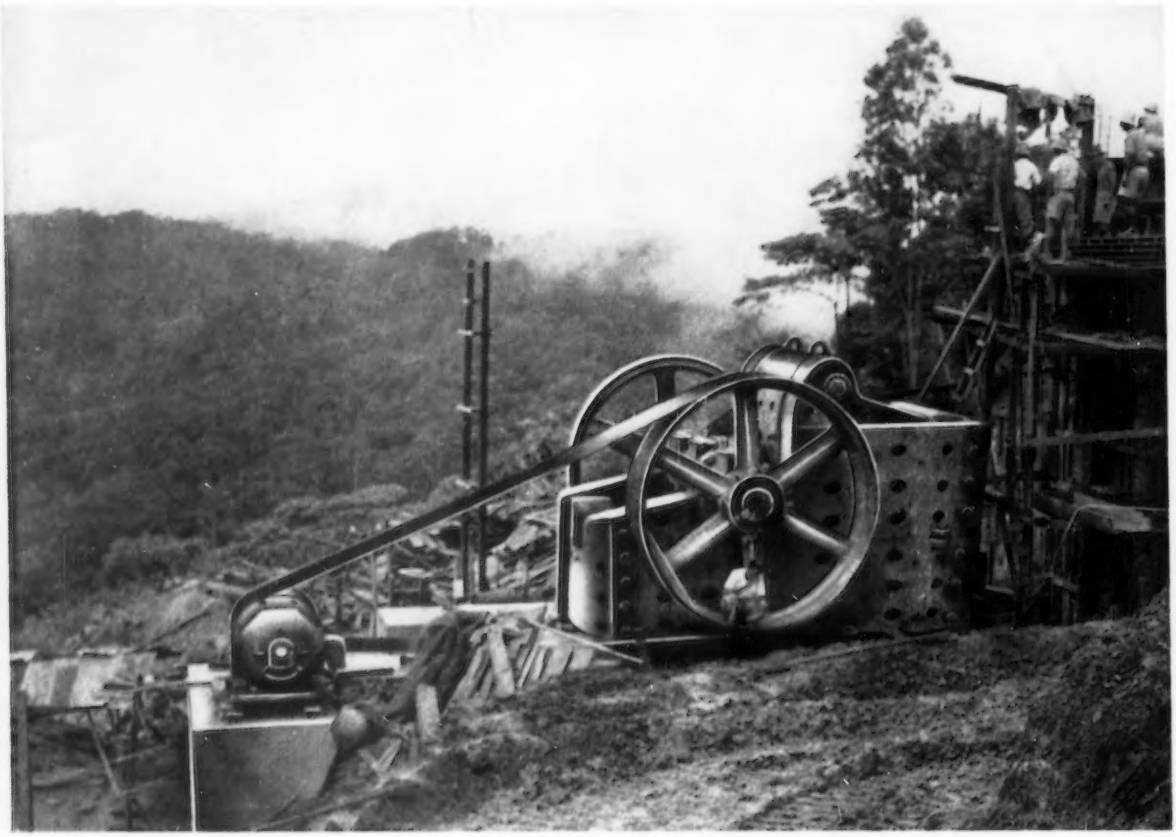

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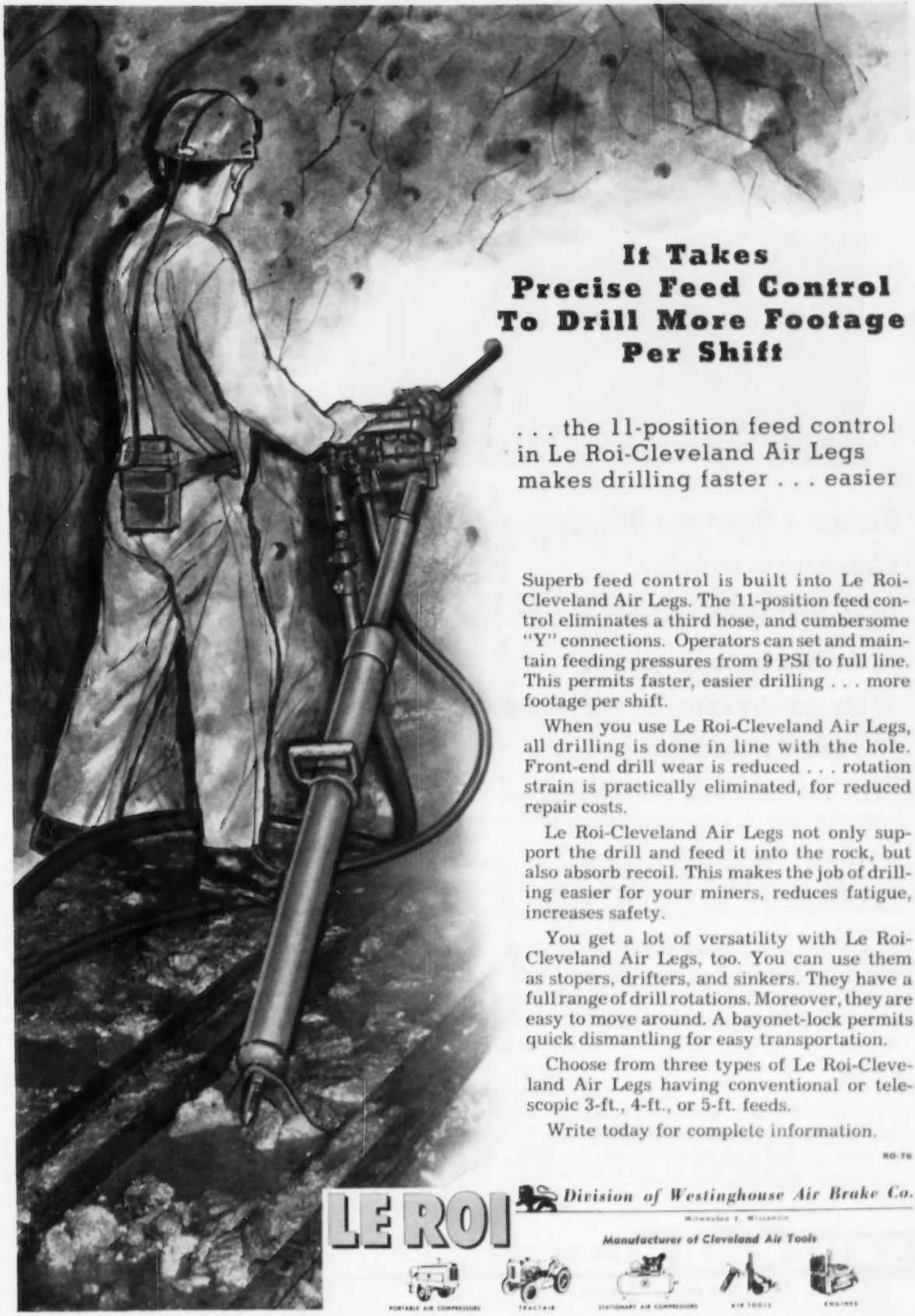

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Wyoming *(Continued)*

a $5-million mill capable of processing 750 tpd. They have indicated preference of locating in the Gas Hills.

Lost Creek subsequently announced it would amend its proposal to increase plant capacity and change location.

The amended proposal calls for a $2- to $3-million plant capable of processing 400 tpd. located midway between the Crooks Gap and Gas Hills areas on the Sweetwater River.

Lost Creek said it has about 90,000 tons ore blocked out at its Sno-Ball claims in the Crooks Gap area and has ore assignments from Savannah Construction Co. claims in the Gas Hills area.

Phelps-Dodge Corp. has sent a crew of 40 men into the Crooks Gap area of Fremont County to test properties of Mile High Minerals Co.

The firm is reported to be considering an option on the property. The testing and development program is estimated to cost $2.5-million.

Mile High found several zones of uranium ore last year, some as deep as 800 ft. Under terms of the proposed option agreement, Phelps-Dodge will do extensive drilling, some as deep as 1,000 ft.

Bethlehem Steel Corp. has purchased about 500,000 tons of bentonite on claims in Wyoming's southern Johnson and northern Natrona Counties.

The firm has options to purchase an additional 1.5-million tons on claims in the same area.

Purchase price was not disclosed. The claims cover an area of nearly 2,000 acres.

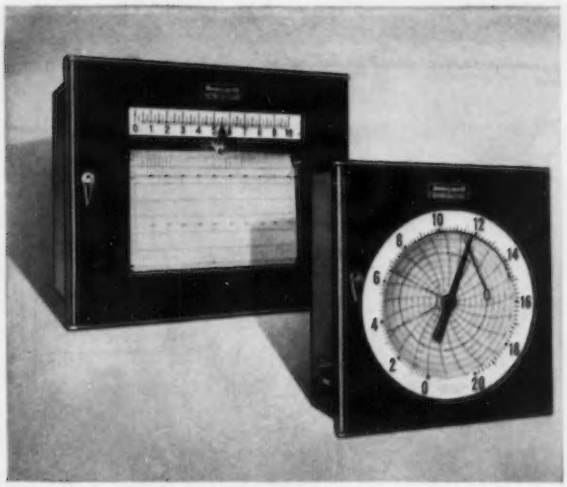
IN CANADA

ONTARIO

Nama Creek Mines is gearing its lithium property in the Beardmore area, 32 miles north of Nipigon harbor on the north shore of Lake Superior, for production on a basis of 1,000 tpd. A 4-compartment shaft is being sunk to 780 ft with five levels. Diamond drilling, completed last fall, was estimated to have indicated 4,292,332 tons grading 1.06% lithia to 1,000-ft depth in two dikes.

Paymaster Consolidated Mines has optioned a 66-claim lead-zinc prospect, some 25 miles south of Timmins in Cleaver Twp., Porcupine area. A high grade lead-zinc discovery is reported on one of the claims. Plans are under way to start work as soon as possible. Investigation will include geological and geophysical surveys.

A substantial increase in tonnage of drill-indicated ore has been made by Maybrun Mines as a result of recent work at the company's Kenora area copper-gold property. The original 740,000-ton figure has now been upped to 1,510,000 tons grading 1.59% copper and 0.064 oz gold per ton. This tonnage is considered sufficient to maintain a 1,000-ton milling operation for 4.5 years. With



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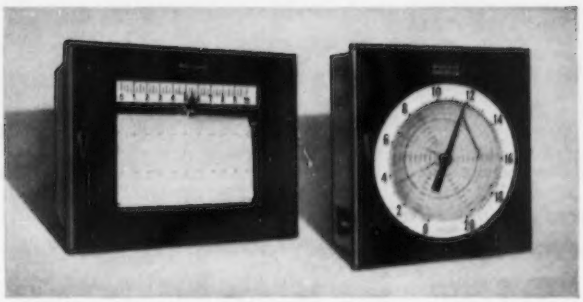

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Millivoltmeter Instruments. Dependable, accurate service at low cost. Plug-in unit design speeds servicing. *Pyr-O-Vane* controllers, in either horizontal or vertical case, offer snap-action or time-proportioning electric control.

No need to "shop around" for instrumentation to fit your temperature measurement or control problem. From the Honeywell line—the most complete and diversified in the industry—you can be sure of getting exactly what your application requires.

Your local Honeywell engineer will be glad to consult on your requirements. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

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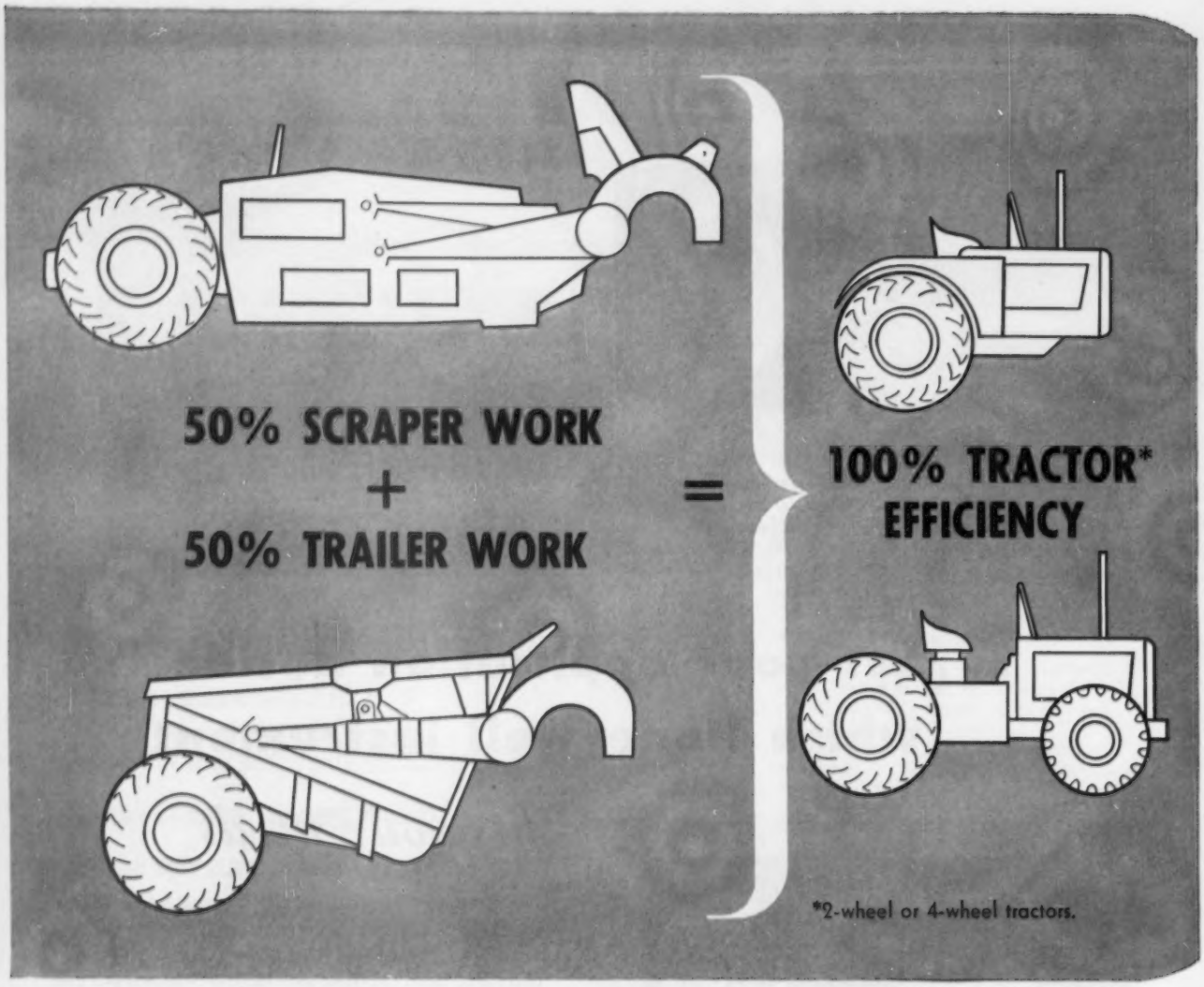
BROWN INSTRUMENTS
First in Controls



Scraper for dirt, Rear Dump Trailer for mixed materials — a complete team for any hauling job. Add the PR21 to your present tractor-scraper units for full efficiency of your tractors and a complete team for any job.

COMPARE THE INVESTMENT:

TRACTOR	SCRAPER	PR21	*YOU **SAVE** THIS CAPITAL*
TRACTOR	SCRAPER	TRUCK	

The diagram above shows the proportional investments required for a tractor-scraper-trailer team and a tractor-scraper plus truck. You save approximately 1/3 by adding the PR21 as against a comparable sized truck. And when you work the PR21, you work your tractor, too. 100% efficiency with the least possible investment.

DOUBLE THE USE OF YOUR PRESENT TRACTORS*

Athey PR21 Rear Dump Trailers interchange with Scrapers for complete job adaptability.

100% efficiency with your present 2 or 4 wheel tractors means big savings for you! With the Athey PR21 and a Scraper you have full coverage on any mixed material hauling job. Use the Scraper for dirt and overburden—the PR21 for rock and mixed material. Self-loading or shovel loading—you have the equipment to do the job. You save approximately ⅓ of your initial capital investment and get 100% tractor efficiency.

Conversion is easy and fast — no additional parts or attachments are needed. Additional savings can be realized by ordering the PR21 less tires and wheels and interchanging the Scraper tires and wheels.

The PR21 gives many advantages you can't get in comparable sized trucks — maneuverability with a 33½ ft. turning diameter, quick loading with a big target body and a low loading height, safety with a low slung design that keeps the load close to the road, fast 18 second dumping with simple, sure hydraulic controls, independent braking of tractor driver and trailer wheels, retracting wheelbase for working close to the fill or hopper. All these profit-packed advantages are yours with the PR21. Why tie up your working capital in limited duty trucks?

Athey

PRODUCTS CORPORATION
5631 West 65th Street, Chicago 38, Illinois

(Advertisement)

SAFETY INSURED—When a 41,300-lb. section of stone crushing equipment was placed by an American 700 Series Crawler Crane, Crosby Clips were used on all wire ropes to assure maximum safety for men and equipment. Genuine drop-forged, hot-dip-galvanized Crosby Clips, with the famous Red-U-Bolt, are specified for safety on more jobs than any other drop-forged wire rope fasteners.

STRONG SAFE, BLOCK

When cofferdam sheetings were about to be drawn from the sucking, grasping soil of the Platte River bottom, a Load-Rated Crosby Crane Block was specified. Made of highest-quality steel, and engineered for safety as well as efficiency, Crosby Blocks are backed by the famous Crosby name—recognized leader in safety. When using Crosby Blocks, workmen can't go wrong, for the safe lifting capacity is embossed right on the side plates.

EASY TAKE-UP

Important design advances by the makers of famous Laughlin Turnbuckles offer added safety and efficiency to users in the construction field. Laughlin Turnbuckle bodies have extra-heavy hex ends which allow fast, easy take-up with a wrench. An exclusive eye design takes the ear of a shackle one size smaller and is stronger than conventional eyes because it conforms more closely to the lines of pull. This design also makes it easier to attach thimbles and other fittings. Exceptionally strong, Laughlin hooks have added heft at points of greatest stress—the ¼-inch hook is actually stronger than most ⅜-inch hooks. Available in a complete range of sizes. A reference chart in Laughlin's free catalog lets you select the proper size turnbuckle for each job.

ATTACH IN SECONDS

A more efficient clevis grab and slip hook made by Laughlin has a "Crimp Style", cotter that can be removed and attached in seconds. Available in a complete range of sizes at distributors everywhere, Laughlin Clevis Grab and Slip Hooks are made of drop-forged steel special forging quality and are heat-treated for maximum strength. For free catalog on the complete Laughlin and Crosby lines, write the Thomas Laughlin Division, Portland, Maine, or the American Hoist & Derrick Co., St. Paul 1, Minnesota.

Ontario *(Continued)*

shaft sinking completed, four headings are being advanced on two levels.

Stancan Uranium Corp. has applied to Eldorado Mining and Refining for premium price contract covering uranium concentrates to be produced from its properties in the Quirke Lake sector of the Blind River area. Tonnage indicated, probable and possible, has been calculated at 1,575,000 tons averaging in excess of 0.11% uranium oxide. Preparations for sinking of a production shaft, auxiliary shaft, and choice of mill site have been made.

Lateral work is under way at the copper property of Coppercorp Ltd. in the Mamainse area, 60 miles north of Sault Ste Marie. Sinking of a 3-compartment shaft has been completed to initial objective of 550 ft. A sampling plant is being constructed. Surface diamond drilling is being continued.

Consolidated Sudbury Basin Mines is proceeding with production plans for its large base metals property, 12 miles west of Sudbury. A 3,000-ton mill is to be constructed and preparations are now in progress. Some production is scheduled as early as June 1957. The first stage will be a concentrating plant to produce copper, lead and zinc concentrates for shipment to custom smelters and a pyrite concentrate for shipment to acid makers.

Kerr-Addison Gold Mines in the Larder Lake area, Canada's largest gold mine, milled more ore and produced more gold in 1955 than in any previous year. A total of 1,660,533 tons were milled for recovery of 427,193 ozs gold. Ore reserves at year end totalled 15.2-million tons, adequate for more than nine years milling. Average grade of reserves were upped from 0.296 to 0.311 oz gold per ton. Diamond drilling, to determine best location for an internal shaft, has been started from the bottom, or 3850-ft level.

Main zone on the new deep levels at Campbell Red Lake Mines in the Red Lake area is showing greater continuity and higher grade than encountered on the upper levels. The original, or "A" zone now being opened on the bottom 14th level, shows a continuous ore length of 550 ft, still open to the east. On the levels above, it was opened for 1200 ft. Grade averages $24.50 across 4.5 ft, while on the 13th level a 620-ft stretch has averaged $27.90 across 4.5 ft.

QUEBEC

Diamond drilling to date by Campbell Chibougamau Mines has added a probable 900 ft of ore length to the easterly extension of a copper-gold zone originally tested by Merrill Island Mining Corp. at Kokko Creek, Chibougamau area. Drilling is being continued. In the original test it was estimated that shallow drilling had indicated 275,000 tons grading 2.5% copper, 0.017 oz gold and 0.97 oz silver. Property is held under lease from Merrill Island.

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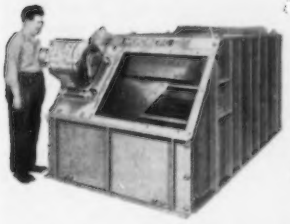
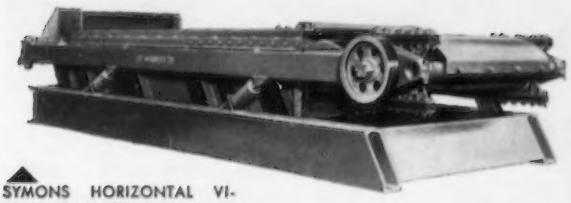
SYMONS VIBRATING BAR GRIZZLIES for heavy duty large capacity primary scalping where clear spacings of 1½" and larger are permissible. Up to 500 tph, handling feeds ranging to 30" and larger.

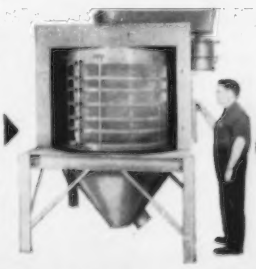


SYMONS VIBRATING ROD GRIZZLIES for heavy duty big capacity scalping. Up to 500 tph, for feeds up to 12". Ideal for scalping operations requiring relatively coarse separations in the range between 1" to 4".

SYMONS ROD DECK SCREENS employ a highly efficient screen deck utilizing individual replaceable steel rods. Features low screening cost—big capacity—low maintenance — long life — ideal for moist and sticky materials.



SYMONS HORIZONTAL VIBRATING SCREENS for level, positive screening with greater capacity of more accurately sized products. Variety of deck combinations, permitting production of a wide range of sizes. Available with dust housing. Ideal for hot, dusty screening with outside drive away from dust and heat.



SYMONS V-SCREENS give unequalled high capacity for sharp, single cut, wet or dry separations, especially in the finer sizes. This high capacity, sharp separation is the result of centrifugal force—an exclusive Symons V-Screen feature.

SYMONS VIBRATING SCREENS have been serving the mining and quarrying industries for over twenty years. The wide range of types and sizes enables you to select exactly the *right* screen for your particular application.

These quality screens have gained an enviable reputation for dependability, efficiency and economy . . . backed by the same high standards of accuracy, design and workmanship, and the same advanced engineering that is used in the manufacture of *all* Nordberg Machinery.

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Quebec *(Continued)*

A shaft sinking program is planned by Duvan Copper to explore deeper horizons at its copper property some eight miles southwest of Normetal. Present shaft at a depth of about 500 ft will be deepened an additional 400 ft to permit opening four more levels at the 550, 650, 750 and 850-ft horizons.

Preparations for plant construction and shaft sinking are going ahead at the Dore Lake copper-gold property of Quebec Chibougamau Goldfields property in the Chibougamau area. Contract has been let for the sinking of a 3-compartment shaft to 1,000 ft with a minimum of 4,000 ft of underground lateral work. Drilling, in the meantime, is continuing to provide encouraging results. Better than 1-million tons of good grade copper-gold material are indicated by diamond drilling to 700 ft and recent drilling has shown better widths and higher grade below that depth.

Drilling has resumed at the jointly-owned property of Coulee Lead and Zinc Mines and Headway Red Lake Gold Mines in the Oka area, some 35 miles west of Montreal. In previous drilling on the north zone, 15-million tons grading 0.02% uranium oxide, 0.3% cerium, 0.01% thorium, 5.7% apatite and 0.39% columbium were indicated along a length of 1,200 ft to depth of 500 ft. Current work will probe for extensions of the zone both laterally and at depth.

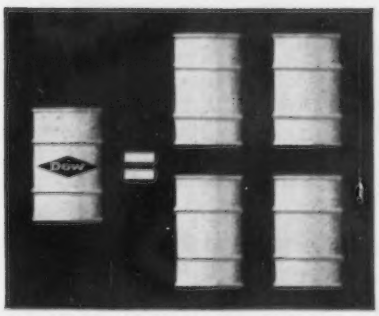
Aconic Mining Corp. plans to operate its 4,000-ton pilot plant as a first step in bringing its big, low grade, magnetite sand deposit into production. The 60-sq mile concession lies on the coast on the north side of the St. Lawrence River, near Anticosti Island. Bore holes put down in a 2-sq mile area indicated reserves of 220-million tons of magnetite sand, grading 4% free magnetite to an average depth of 65 ft. The company estimates that it will recover about 16-million tons of 65% magnetite concentrate to depth of 130 ft in the closely explored area.

Continued drifting and drilling are enlarging two new orebodies encountered last year at Golden Manitou Mines property in Bourlamaque Twp, nine miles east of Val d'Or. Ore length of better than 1,000 ft has been opened by drifting on the 2790 level with the face still in ore. Headings are also being advanced in ore on the two levels immediately above. Zone had indicated an estimated 206,900 tons grading 8.35% zinc, 0.04 oz gold and 6.46 ozs silver per ton and this figure has since been increased. The copper zone has been estimated to contain an indicated 910,000 tons above the 810 to the 310-ft horizon. Continuity below the 810-ft level has been indicated by recent diamond drilling.

Production of nearly 24-million lb of copper is predicted for the current year for the copper-gold mine of Opemiska Copper Mines (Quebec) Ltd. in the Chibougamau. It is now planned to step the mill up to 1,200 tpd by early 1957.

Lab and mill men agree—Dowfroth is effective with as little as one-fourth the quantity of other frothers. The metallurgical results are excellent.

point of agreement: Dowfroth 250 most effective



Money-saving arithmetic. One drum of Dowfroth 250 can equal four of other frothers on your ore. Dowfroth 250 also has definite uniformity of properties and is readily available in drum or tank-car quantities.

Lab metallurgist or flotation operator—both prefer DOWFROTH!

The man in the lab—because Dowfroth® 250 is noncollecting, is water soluble and produces a clean, lively froth over a wide range of conditions. It gives him more precise control, yet better accommodation to test variations.

The man in the mill—because the action of Dowfroth 250 is rapid and under control—because Dowfroth gives concentrate froths that are easy to launder, pump and thicken—because Dowfroth doesn't deteriorate rubber parts—is pleasant to handle.

There's still more to the story. Management prefers Dowfroth 250 because it makes milling more profitable. Superior water solubility means more frother returned in water recovery systems. Dowfroth improves concentrate grade and mineral recovery.

Save money in your flotation *process* by using Dowfroth 250—and the superior collecting agents, Dow Xanthates. A new Dow product is Separan 2610®, a superior flocculant already popular in the industry. Samples of these products and technical assistance are offered by THE DOW CHEMICAL COMPANY, Midland, Mich., Department OC 856L-1

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Wagon Drill that
really gets around!

the G-800 Tracdril

- Self-Propelled
- One-man Operated
- Tows Own Compressor

Combine the drilling speed of the hard-hitting CP-70NDC Drifter with the adaptability of a CP Drill Carriage and U-arm . . . add the maneuverability of a self-propelled track-mounting that tows its own air supply over rough terrain . . . and you have the One-Man CP Tracdril.

Reversible tramming motors enable the Tracdril to go forward, backward and pivot . . . for faster "moving time" from hole-to-hole, more accurate spotting and more time for productive drilling. "Knee-action" tracks keep the hydraulically operated U-arm support level when operating on uneven ground. The Tracdril has plenty of reserve power . . . can tow a 13,000 pound CP 900 c.f.m. Rotary Compressor up a 10% grade. For details see your CP equipment distributor.

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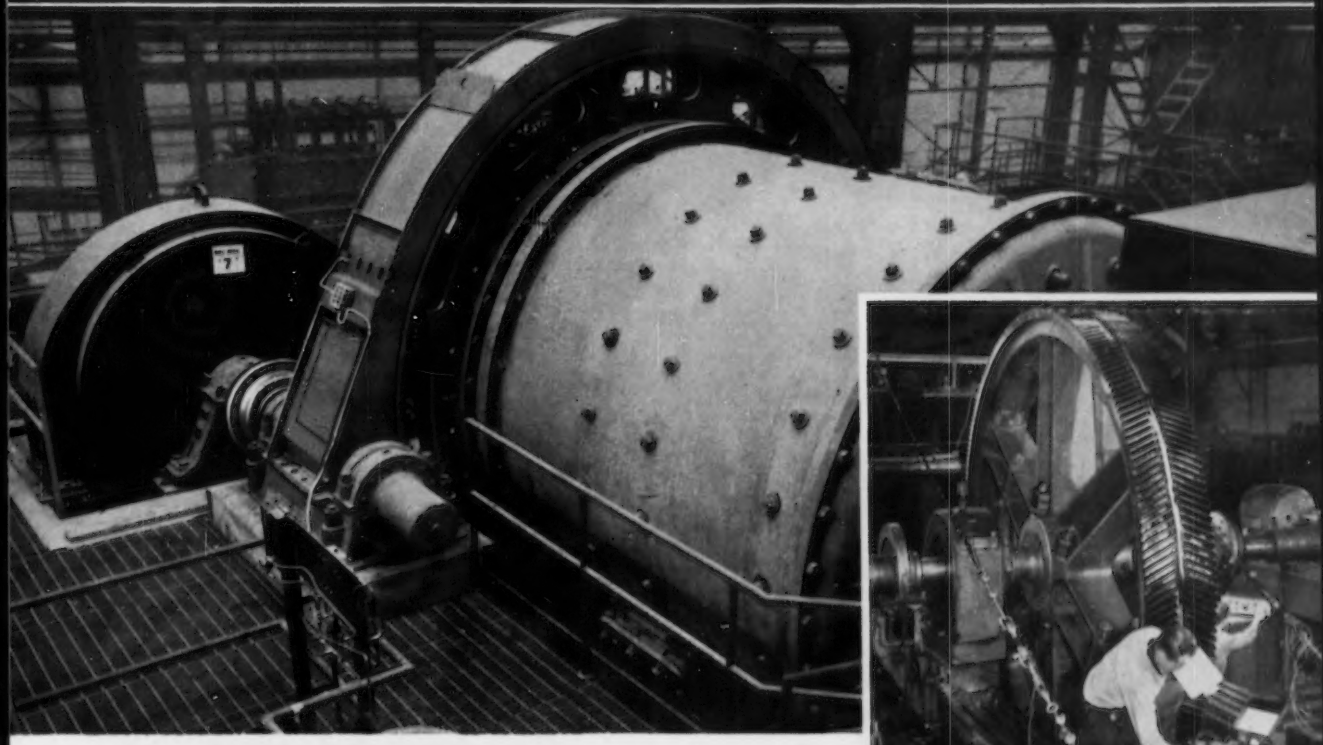
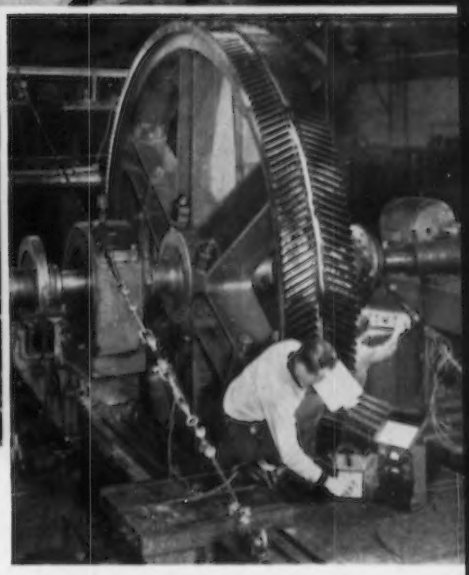
HELICAL GEARING BY **FALK** ...FOR MILLS AND KILNS





Falk Gears are *the Most Efficient* you can buy...

and are the most economical in the long run!

These are broad claims—but they have been proved beyond question by countless laboratory tests and confirmed by the actual experience of leading mill and kiln operators and engineers.

Falk ring gears transfer the gear tooth load directly to the shell flange of mill or kiln. They are correctly designed and of rugged proportions for maximum rigidity and accuracy. These helical gears—with extra-depth, extra-capacity teeth—provide a single-mesh, high reduction ratio drive giving you these advantages:

- Gear efficiency of 98+% (see column at right)
- High motor speeds—hence saving in motor and power costs
- Smooth helical gear action
- Maximum resistance against abrasive wear
- Longer service life of gears and of driving and driven machinery

This all adds up to the highest efficiency and greatest over-all economy. Don't compromise with quality on your gearing. *Insist upon Helical Gears by FALK*—the country's pioneer and leading supplier of precision gearing.

Consult any Falk representative—also, write for **Engineering Report 6170,** "Advantages of Helical Gearing."

THE FALK CORPORATION, 3001 W. CANAL ST., MILWAUKEE 1, WISCONSIN

GEAR EFFICIENCY PROVED BY SPECIAL LABORATORY TESTS

In the Falk Mechanical Test Laboratory, continual full-load tests of helical gears and gear units are conducted to provide accurate data on gear efficiency. Load efficiency, speed, lubrication and capacity tests are made.

The above photo shows the use of special testing equipment to obtain data on mechanical efficiencies of Falk helical gears. Tooth pressures corresponding to rated capacity and speed are applied through a loading device equipped with strain gages for accurate load measurement. Power losses are determined by an accurately calibrated torque meter on the connecting shaft of the motor.

Test data show the average tooth-mesh loss for a single-reduction set of Falk Helical Gears is *less than* 1½% of the rated capacity. Thus, the efficiency of the gears is 98½% *or greater*—proof that Falk Helical Gearing is the most efficient obtainable.

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...a good name in industry

...and NOW the newest synthetic fibers POLYETHYLENE, DACRON*** and TEFLON††.

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Because — today's filter cloth requirements in the chemical and allied fields are so complex that special service and techniques are essential

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. . . for your Filter Paper requirements try NETONE Filter Paper. High Tensile strength, chemical resistant, high burst factor, abrasion resistant and crease resistant. Send for a test sample.

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Quebec *(Continued)*

Recent drilling has indicated new ore extensions and full investigation of these is now under way.

A new company, Copper Rand Consolidated has been formed to take over some 3,000 acres comprising a large part of the holdings of Copper Cliff Consolidated and New Royran Copper Mines in the Chibougamau area. Holdings cover three miles of strike along favorable ore structure. Less than half of this length has been explored to date, but officials estimate that already there has been indicated 10,000 tons of copper ore per vertical foot. They anticipate that the property will be brought into production at a rate of 5,000-7,000 tpd.

NEW BRUNSWICK

Aumacho River Mines has contracted for a 10,000-ft diamond drilling program on its base metals prospect in the Bathurst area. Extensive gravimetric survey, completed earlier this year, outlined two strong parallel zones of density. They range in length from 1,200 to 1,400 ft and range up to 350 ft in length.

Nudulama Mines has started a diamond drilling program on its large base metals prospect southwest of the important American Metal Co.'s deposits in the Bathurst-Newcastle area. Program is designed to test an area where a gravity anomaly is superimposed on an electromagnetic anomaly.

MANITOBA

Green Bay Mining & Exploration Co. reports good lithium bearing mineralization intersected at 300 ft in drilling on its 32 claim property. Company acquired an additional 18 claims adjoining the original holdings. Exploration will commence shortly.

Montgary Explorations reports that diamond drilling at Bernic Lake carried out this winter from the ice, has increased reserves of lithium ore to 4-million tons averaging 1.6% lithium oxide over 41.4 ft.

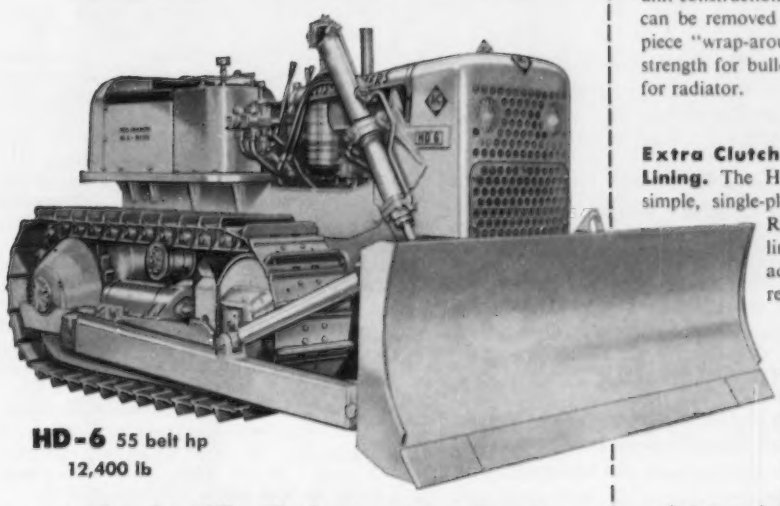
BRITISH COLUMBIA

Recent capital outlays and explorations by several companies have sparked renewed interest in Vancouver Island mining:

1. As part of a huge B.C. investment program, Mogul Mining Corp. Ltd. of Toronto will spend almost $2-million to develop copper mines in the Lake Cowichan areas.

Mogul has in the last six months advanced about $47-million for mining in Canada and, states J. Alex Swanson, Mogul's B.C. representative, "Mogul will advance about $5-million more in B.C. mining deals."

This kind of Crawler Tractor Design gives you extra mining output



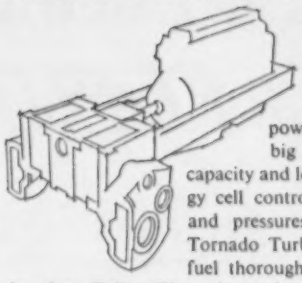
HD-6 55 belt hp
12,400 lb

. . . and only Allis-Chalmers HD-6 has it—
advanced design features that combine big performance, versatility, dependability and simplified servicing!

Look at the Allis-Chalmers HD-6—you can see its functional design . . . how it's built to give sure-footed traction, better working balance. But there's more to this crawler tractor than meets the eye—the performance advantages of Allis-Chalmers advanced basic design. It provides more working power, more strength in all components, more working weight where it's needed . . . makes the HD-6 an outstanding performer with drawn or mounted equipment . . . easier to operate and maintain.

Let your Allis-Chalmers dealer show you how the HD-6 can give you that *extra* output on your jobs.

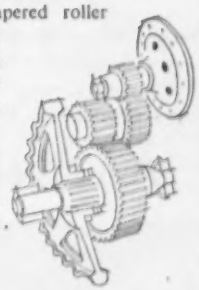
ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION
MILWAUKEE 1, WISCONSIN



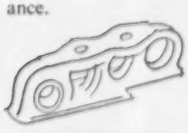
Allis-Chalmers Heavy-Duty Diesel Engine. The HD-6 power plant is designed for big output, ample reserve capacity and low maintenance. Energy cell controls combustion timing and pressures for high efficiency. Tornado Turbulence mixes air and fuel thoroughly for more complete burning. Follow-Through combustion sustains effective working pressures to take advantage of better crankshaft leverage.

Special Strength and Protection. Exclusive all-steel box-A main frame makes possible superior over-all balance, better equipment mounting . . . plus service simplicity of unit construction. Major assemblies like engine and clutch can be removed without disturbing adjacent parts. One-piece "wrap-around" radiator guard provides maximum strength for bulldozer mounting . . . complete protection for radiator.

Extra Clutch Life—with Ceramic Lining. The HD-6 master clutch offers simple, single-plate, over-center design. Revolutionary new ceramic button clutch lining keeps clutch operating longer between adjustments . . . lengthens clutch life . . . reduces lever pull for easier operation.



Straddle-Mounted Final Drive Gears. Tapered roller bearings support both ends of the final drive gear shafts. Smaller gears and shorter shafts (plus line-bored, one-piece case), provide better bearing and gear alignment, more strength, longer life. Double-reduction final drives provide greater ground clearance.



New-Design, Heavy-Duty Track. HD-6 track provides long life under the toughest conditions. HD-6 sidebars have more steel where it's needed . . . benefit from new heat-treating methods which make possible new standards of strength and hardness throughout for extra wearability.

Other Outstanding HD-6 Features

. . . no other tractor in this size class has them—at no extra cost you get roller bearing truck wheels, idlers and support rollers; 1,000-hour lubrication intervals for truck wheels, idlers and support rollers; 24-volt direct electric starting; crankcase guard; bumper; and lights.

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Bemis makes all grades of flexible ventilating tubing. One of them fits your job to a T . . . and at a money-saving cost . . .

Jute Grade FLEXIPIPE—Strong, durable, light, acid-resistant . . . this is the standard, versatile tubing of the industry. A regular workhorse. Weighs a fraction as much as metal pipe . . . much lower in cost, easier to handle, install and move. Good for long, rough usage.

Bemis Nyprene FLEXIPIPE—If you need a real "featherweight" flexible tubing that is also amazingly tough and durable and not affected by acids, specify Bemis Nyprene FLEXIPIPE.

Bemis Heavy-Duty FLEXIPIPE—What its name implies—made of a particularly tough, heavy-duty fabric that is treated to be highly resistant to gases, heat, fungus, acid and mine waters . . . everything.

You'll Also Profit by Using . . .

Bemis Rope Seam Suspension—The finest suspension . . . and costs you nothing additional. No sagging. Sliding clamps can be moved to the nearest support and hung on suspension nails. No horizontal wires, vertical collars, hooks or other gimmicks.

Your Ventilating Job is Our Job!

For mine or tunnel ventilation, Bemis FLEXIPIPE is rugged, long-lived, economical.

FLEXIPIPE is light . . . easy to handle and install.

Bemis NO-SAG Rope Seam Suspension costs you nothing additional.

Write, wire or phone for full information about Bemis FLEXIPIPE

Bemis

408-E Pine Street
St. Louis 2, Missouri

British Columbia *(Continued)*

A 500-ton mill will be built at the Cowichan Copper Co. Ltd. property and after 18 months it may be enlarged to 1,000 ton capacity.

Already sufficient ore of about 4% grade has been surveyed to feed a 500-ton mill and it is believed that two months more work will block out sufficient for a 1000-ton mill.

Officials state that on the new 1100-foot level which is advanced to a point of 1108 feet from the portal, a hole was diamond-drilled 15 deg to the left of the strike. At 436 to 488 ft it caught 52 ft of mineralized rock which averaged 3.74% copper. This is believed to be a downward continuation of the main orebody. It increases the known depth of ore from 300 ft to 640 ft from the surface.

Assays ranged from 9.06% at 436-442½ feet, to 2.05% at 484-488 feet.

2. In the northern part of Vancouver Island, the Quatsino district is attracting considerable attention, after being dormant for many years.

Coast Copper Ltd. (controlled and managed by Consolidated Mining and Smelting Co. of Canada) has one of the most promising properties. Exploration is under way and reports indicate that future production is assured.

3. Noranda Explorations Ltd. have opened an orebody grading about 5% copper at the 1900-ft elevation on the Yreka property—also in the Quatsino area. They have reported that equivalent results on the 1750-ft level would justify immediate production.

4. A new company, Alice Lake Mines Ltd. has been organized by Vancouver interests who have taken up extensive ground in the Lake Alice area where copper was mined 50 years ago.

5. Quatsino-Copper Gold Mines, with considerable property adjoining Coast Copper territory, reports that together with a large contracting firm, it is negotiating with steel mills for delivery of iron ore on a long term contract basis.

Indicated iron on the company's property to date, with only a small part of the magnetite zone drilled is estimated at from 2.5-million to 3-million tons.

6. Rosea Mines Ltd. has purchased a group of claims on the Robertson river in the Cowichan Lake area.

Hector Stone, president, said his company has bought the claims which are adjacent to Copper Ridge holdings and approximately five miles from the Cowichan Copper Mine.

Surface stripping has indicated a mineralized zone from which samples of massive chalcopyrite have been obtained, Stone reported. The showing has been placed before consulting engineer F. J. Hemsworth.

Rosea also holds copper claims at Tahsis on the west coast of the island.

The booming mining town of Yellowknife in the Northwest Territories now has an overland link with the "outside."

The settlement's only overland link was completed in March when five trucks owned by Grimshaw Trucking and Dis-

This Headed Roof Bolt helps prevent roof falls

Roof falls, resulting in injury and loss of production, are less likely when you use roof bolting, with Bethlehem's square-head roof bolt. This method of roof support promotes safety because it anchors overlying rock. What's more, roof bolting offers these other worthwhile advantages: (1) improved ventilation, due to the absence of bulky supports, (2) increased production through greater freedom in operating mechanized equipment, and (3) less need for storage space, both above and below ground.

Used with Expansion Shell

The Bethlehem square-head roof bolt owes its positive locking action to the leaf-type malleable-iron shell with which it is used. When the bolt is tightened, the leaves of the shell expand, providing a firm four-way grip against the sides of the hole. A square roof plate provides additional support. A hardened washer, furnished with the assembly, reduces friction between the bolt head and roof-plate.

Bethlehem also manufactures a 1-in.-diam slotted roof bolt, used with a steel wedge. This bolt, because of its larger diameter, is ideal where maximum strength is required. It is also suitable for pillar bolting. When installed, the wedge is driven into the 6-in. forged slot, spreading the bolt-ends to fill the hole.

If you would like to consider a roof-bolting program, we suggest you would find it worthwhile to talk with a Bethlehem representative. Just get in touch with our nearest sales office.

TYPE	DIAM	TYPICAL BREAK LOAD, LB
Carbon	¾ in.	24,000
High-Strength	⅝ in.	24,000
High-Strength	⅞ in.	45,000

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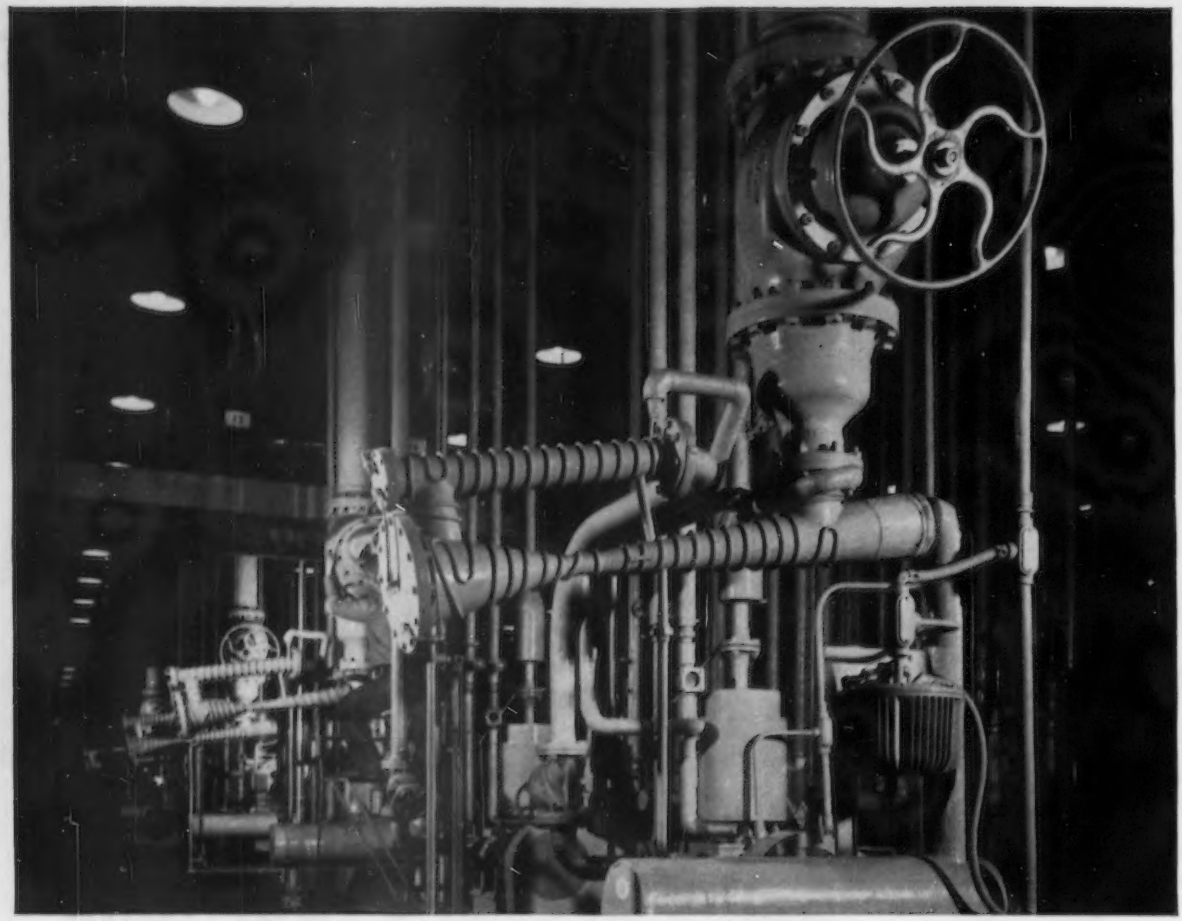

These Crane valves holding 25 microns absolute pressure after 2 years on vacuum service

The Case History—Valves frequently are the most critical points in a vacuum system. But that's not the case with this large Southern light metals refiner.

This plant reports no trouble or expense over a 2-year period in maintaining a vacuum of less than 25 microns absolute for its distillation process.

The tight-holding valves installed about 2 years ago on the lines from vacuum pumps shown above are Crane No. 1611 diaphragm pattern. These 12-in. packless iron body valves are used about once daily.

They've allowed no in-leakage at the seat, bonnet-joint, or through the diaphragm. No maintenance whatever has been given the valves since installed. They operate easily and look good for such service indefinitely.

This high efficiency performance is mainly due to Crane separate disc and diaphragm design. The diaphragm used as a bonnet seal only is not subject to destructive crushing. Conventional type disc and body seat provide a metal-to-Neoprene seating that's ideal for vacuum and hard-to-hold fluids.

Moderately priced, Crane diaphragm valves deserve your consideration for many ordinary services, as well as sludges, slurries and corrosive fluids. They are made in a wide variety of body and trim materials, in ½ to 12 in. sizes.

Ask your local Crane Representative about them, or write to address below for literature.

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the BIG DRILL that has EVERYTHING

80° DRILLING RANGE

The Joy TWM-5 Challenger will drill at any angle between vertical and 10° above horizontal, making it applicable to almost any range of drilling required.

EXTREME MOBILITY

The TWM-5 is self-propelled on either rubber tires or crawler treads. It is driven on each side by a reversible piston type air motor, can turn in its own length, and can move into and out of most "tight" spots.

REMOTE CONTROL

All functions of operation, both drilling and moving, are controlled from the operator's station on the frame, directly over the left front wheel. Three hydraulic jacks provide stability while drilling.

TM-500 DRILL

The drilling machine on the TWM-5 is the JOY TM-500, a 5¼" piston drill, which has proved itself in quarry, construction, and mining work as the first and still the leader in the big drill field. The TM-500 is mounted on an extra sturdy mast which is raised and lowered hydraulically.

ADDITIONAL FEATURES

Optional features available on the TWM-5 are a cab, designed for the best in operator comfort and protection, and a dust collection system.

Check today on the Joy TWM-5 for your drilling operation. Whether you drill vertical holes or toe holes, it will fit your program and give added rock tonnages from the day it first goes to work. Write for complete information today to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Joy TWM-5 drilling deep holes (50' to 100') in granite in a southeastern quarry.

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Available in single or double end models, with direct electric drive. Also for belt drive. Complete with carriages, turntables, trolleys, etc., as layout requires. Capacities: length, 1" to 10"; 3' to 8' between shoulders; tenon thickness, 3" to 18".

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British Columbia *(Continued)*

tributing Co. rolled into Yellowknife with 30 tons of freight.

The trucks had completed 29 hours of actual travel on the 500-mile trip from Grimshaw, in northwestern Alberta.

Trucks loading in Edmonton (600 air miles away) Monday will be able to deliver freight in Yellowknife Thursday. The only previous means of prompt service was air freight.

The portion of the Grimshaw-Yellowknife road in the Northwest Territories has been authorized by the federal government as a toll road for two years with pleasure vehicles traveling free and commercial traffic paying a toll of $10 a ton.

Operations of Texada Mines Ltd., B. C.'s leading iron ore producer, are being stepped up to fulfill a new contract with Japanese interests for delivery of 700,000 tons of magnetite concentrate.

Shipments will begin in August.

Texada's general manager B. L. Alexander reports the growing Japanese appetite for B. C. iron ore means: 1. about 30,000 tons of concentrate will be shipped each month, calling for overall mill capacity of 2,000 tpd; 2. a $1-million renovation and expansion of mill facilities, to be completed in August; 3. opening of an important new orebody; and 4. plans for recovery of some 500 tons of copper concentrate a month from the iron ore (the copper had proved a nuisance in past operations.)

Texada has opened up the Cameron-Yellow Kid mine, and nature of the ore there will require a new treatment process. But it's expected to yield a concentrate grading about 64% Fe.

Iron Mask Mine area south of Kamloops is the scene of developments by several mining companies:

1. Kamloops Copper Co. reports that it will reopen its old Iron Mask mine, closed since the 1920 copper tumble. The company has the financial backing of Wolverton and Co. Ltd., which has agreed to provide Kamloops Copper with $50,000 as a firm commitment.

A contract has been let for a 150-ft tunnel at the 100 ft level. Equipment has been moved into the mine and the B. C. Power Commission has agreed to connect a 20,000-volt line.

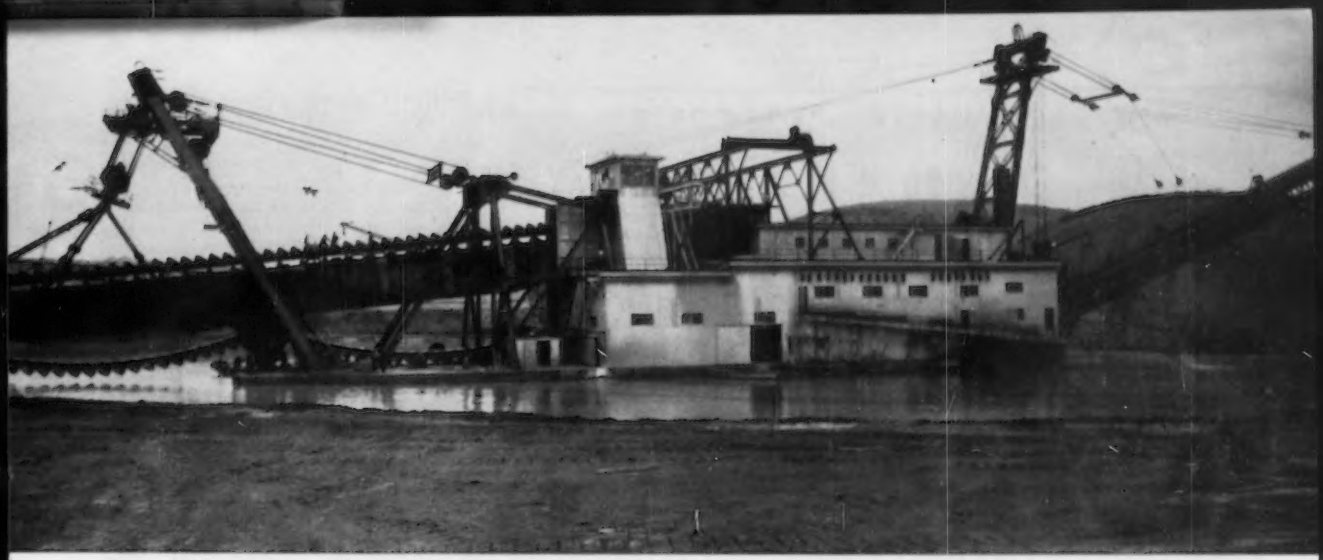
2. Makaoo Development Co. Ltd. has diamond drills operating in the area in cuts on which surface assays showed copper at .45% for 10 ft, .90% for 10 ft, and 2.5% for 5 ft, according to the company reports.

Underground drilling on the ore zone surface is going on and in addition will also be done to depth on the main zone which parallels the zone now being tested underground.

Granduc Mines Ltd. is in the throes of the largest freight haul it has ever attempted.

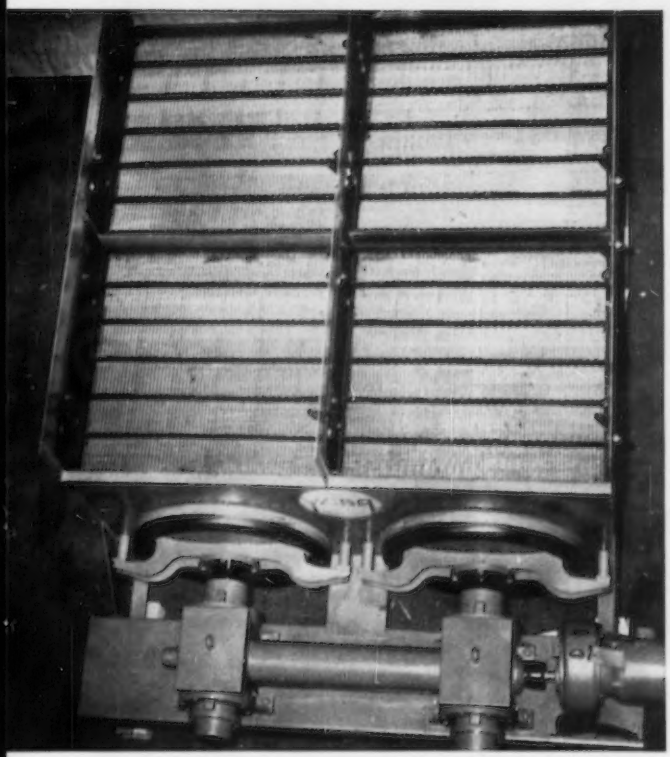
The company is moving 2,000 tons of freight into its property on Leduc glacier, 25 miles north of Stewart.

President L. T. Postle reports, explorations there indicate 25.6-million tons ore with an average copper content, without allowance for dilution, of 1.62%.



Four of these dredges move about 13,000 yards of placer material in each 22 or 23 hour day.

"In our mineral jigs, the Stainless Steel *just never wears out!*"



A typical mineral jig, showing the Stainless Steel screen. A dredge may have as many as 48 jigs.

says H. A. Sawin, Asst. Director of Sales, Yuba Manufacturing Company San Francisco, Calif.

It's no secret that gold mining is big business. It has to be, because it takes whopping big equipment to seek out the gold missed by the famous forty-niner prospectors. The Yuba dredge, shown here, weighs more than a Navy destroyer, and it cost about $2 million.

So gold mining is like a factory operation, and a watchful eye must be kept on costs. On the basis of *performance alone*, Yuba is changing to special steels, like Stainless, wherever abrasion and corrosion become a problem.

In the dredge, for example, the screened gravel flows over a pulsating bed made from Stainless Steel wire. But they have no record of replacement costs, for the simple reason that none of the Stainless has worn out since it was originally installed seven years ago! Needless to say, any other metal would have gone to the junk pile years ago.

Think of Stainless Steel for its *combination* of properties: abrasion resistance; corrosion resistance; very high strength; a smooth, dense surface; easy cleanability and fabrication. And when buying Stainless, specify USS Stainless Steel if you want to be sure of service-tested quality.

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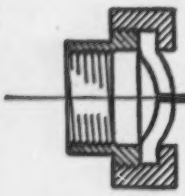

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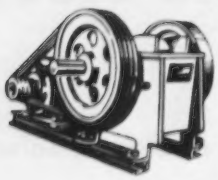
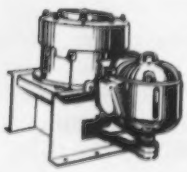


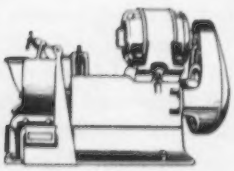
4" x 6" MASSCO LABORATORY JAW CRUSHER

Welded steel frame; manganese steel jaw and check plates; bronze bushed bearings; smooth jaws give better product and easier cleaning. Adjustment for plate wear and product size by convenient hand wheel.



MASSCO GY-ROLL REDUCTION LABORATORY CRUSHER

Reduces ½" feed to as fine as 10 mesh in single pass. High capacity, low power consumption. 6" and 10" sizes.



MASSCO-McCOOL PULVERIZERS

Disc type grinder with planetary movement. No gears. Will grind from ¼" to 150 mesh in one pass.

MARCY PULP DENSITY SCALE

Gives *Direct Reading* of weight of sample in grams or kilograms; specific gravity of liquid, specific gravity of pulp; percent solids contained in a pulp of any given specific gravity; specific gravity of dry solids. Is very accurate and easy to keep clean.

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The Mine & Smelter Supply Co.

WRITE FOR CATALOG

British Columbia *(Continued)*

The company has spent more than $850,000 driving tunnels and drilling.

Meanwhile general manager J. J. Crowhurst has announced the company may establish a blister copper smelter alongside the mill planned for Bear River Valley.

IN LATIN AMERICA

MEXICO

A $1-million development and expansion program is now underway for the mine and mill at a copper-lead-zinc-gold-silver mine near Sombrerete, Zacatecas, being operated by Compañia Minera San Martin, of which William D. Pawley, of Miami, Fla., former U. S. ambassador to Brazil and Cuba, is president.

A new bank of flotation cells has been added to make copper concentrate. In addition, the program calls for mainshaft deepening, lateral development of drifts and crosscuts and the purchase of more equipment.

Mill is processing about 7,000 tpm. Lead concentrates are shipped to Cia. Metalurgica de Peñoles' smelter at Torreon; copper concentrates to Asarco's smelter at San Luis Potosi, and zinc concentrates to the American Zinc Co. in Texas.

Ing. Salvador Peña, of the mining tax division of the Mexican Treasury Department, paid tribute to Pawley's "faith and courage" in developing the property after other firms had examined the mine and turned it down.

Gulf Sulphur Corp., through its Mexican subsidiary, Compañia de Azufre Veracruz, S. A., has begun testing its $4-million Frasch process plant at Salinas on the Isthmus of Tehuantepec. Production is to begin in a few weeks.

Gulf's plant, built by the Hudson Engineering Co., has a capacity of 1.7-million gpd of superheated water. It may reasonably be termed as the most modern Frasch process sulphur plant in the world.

Reserves on 75 acres of Gulf's 7,414-acre concession have reported at 13.3-million tons proven and an additional 3-million tons probable.

CHILE

Last year the three American companies in Chile produced 391,400 metric tons of copper of which total 126,500 tons were electrolytic, 151,800 tons were blister and 113,100 tons were fire refined. Strikes decreased output by 24,000 tons.

High grade iron ore produced in 1955 amounted to 1,727,930 metric tons and the grade was better than 60%.

Braden Copper Co. will invest $1,050,000

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Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

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Like all Manhattan heavy duty conveyor belts, Ray-Man is mildew-proof and moisture resistant. R/M's exclusive "XDC" Cover protects the belt against wear, tear, cuts and abrasion to a degree never before attained.

For unusually abusive shock loading, R/M's extra-cushioned Homocord Conveyor Belt may be better suited for your job. An R/M representative will help you compare the advantages of all R/M Conveyor Belts to determine the one that will cut your handling costs most . . . give you "More Use per Dollar" in your operations. Contact him today . . . or write for Bulletin 6906 and 6915.

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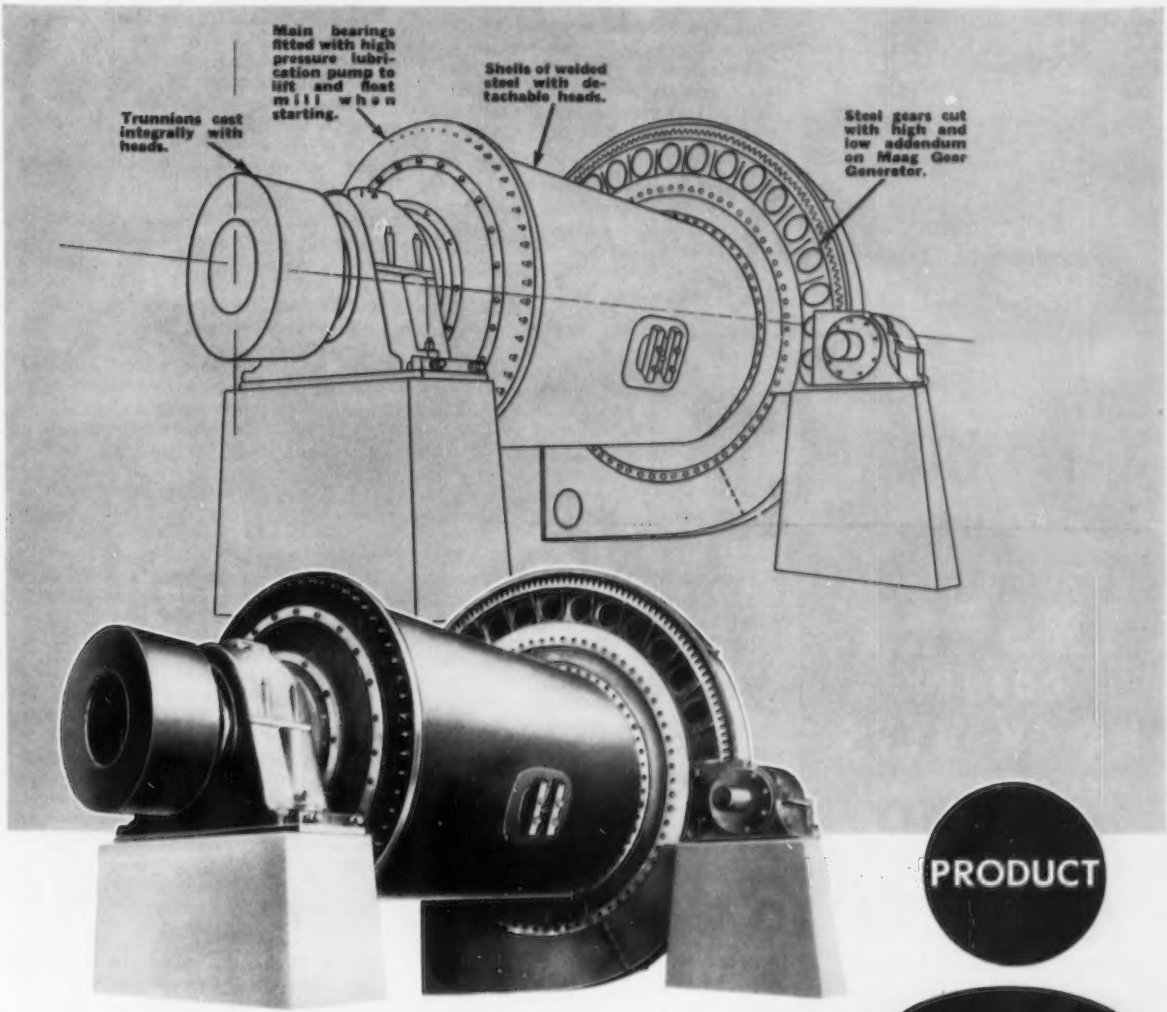
Main bearings fitted with high pressure lubrication pump to lift and float mill when starting.
Shells of welded steel with detachable heads.
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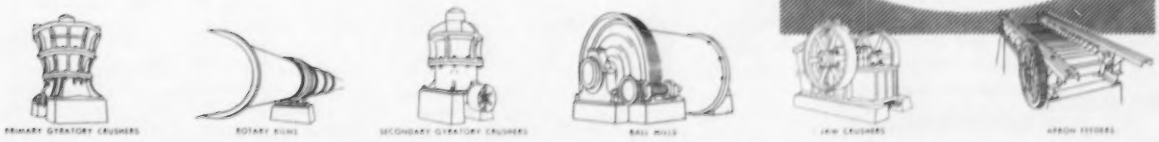

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Chile *(Continued)*

in changing its old Standard Minerals Separation flotation machines to Fagergren cells. The M.S. machines have been in operation over 40 yr, are made of wood and are gear driven. Braden still uses an acid circuit and is the only large copper mill using this type of circuit in the world.

Mining Credit Bank has been revising some of the clauses of its contract with the Norddeutsche Affinerie which refines about 15,000 metric tons of blister copper produced by the Paipote smelter. The bank also sells to the same copper refinery between 8,000 and 9,000 tons of copper ore per year which Paipote buys in excess of its capacity.

Fundicion Nacional de Paipote will build a sulphuric acid plant at the Páipote Smelter using the converter and roaster gases. It will also build a leaching plant to treat the low grade oxidized copper ores which cannot be smelted direct and which Paipote cannot buy from the miners. It is expected that both the acid and the leaching plants will be operating within two years.

The 35-tpd contact sulphuric acid plant built by Corporación de Fomento at the port of Antofagasta will be ready to operate this month and will supply local leaching plants with the necessary acid. It has been designed by Lurgi, Frankfurt, West Germany.

According to the Under Secretary for Mines, the principal uranium deposits in Chile are those of Carrizal Alto, Las Animas, Algarrobo, Los Azules, Pampa Larga and Cabeza de Vaca, all of them located in Atacama province.

According to John Peebles, president of the Anglo-Lautaro Nitrate Co., his company is waiting for the Chilean Congress to approve the Nitrate Referendum, agreed upon by the Chilean Government and the nitrate companies, decided to invest fresh capital in its nitrate enterprises in Chile. New capital is badly needed to improve present operations to face growing competition from the synthetic industry.

IN THE PHILIPPINES

During 1955 Benguet Consolidated entered into ten royalty agreements with options to purchase covering ten separate properties. Six properties were retained after examination, including two gold properties and four chromite. At one of the former, equipment has been ordered and an extensive development program is underway; exploration is proceeding on the others. In addition, on the invitation of the Philippine Government some of the Benguet staff have been looking into the possibilities of the Surigao laterite iron deposits which contain an important nickel content. Company is adding to its staff of geologists.

A bill to expedite the exploration of the Surigao deposits was urged upon the Philippine Congress by the Director of Mines, Benjamin Gozon. Measure would authorize the President to enter into operating contracts through public bidding with domestic and foreign firms. Bureau of Mines estimates the reservation on Nonoc Island contains 35-million tons of ore averaging 1.35% nickel content, making it one of the largest nickel deposits in the world.

Atlas Consolidated Mining & Development Co. reports a net profit of $1,640,000 in the period from April to December 1955. Estimates of ore reserves at the Toledo Mine are stated to be 68.5-million tons with an average 1% Cu. Ore reserves during 1955 were increased over 30-million tons. Before mid-year the company expects to receive equipment for manufacturing acid and fertilizer from the mine's by-product, pyrites, now being recovered at 350 tpd. Late in February the Toledo mill for the first time reached a daily production rate of 6,000 tons. For the month the mill treated nearly 150,000 tons assaying 0.90% copper. Concentrates produced during the month totalled 4,754 tons averaging 21.7% copper, indicating a recovery of about 76% for 1,035 tons of copper.

Lepanto Consolidated produced 4,096 tons of concentrates in February containing 930 tons of copper, thus falling to second place for the first time behind its new rival. However, the sizable gold content of the Lepanto ore more than compensates for the lower copper output. Lepanto will undertake exploration work on some new tungsten deposits in an effort to diversify its activities. The presence of tungsten in the Philippines has been reported for years, but no production has ever been known to date.

Samar Mining Co. made two shipments of copper-gold concentrates from its Masara property in Davao to Japanese smelters. Copper content averaged about 12%.

It is officially estimated that copper production in the Philippines totalled 17,461 tons in 1955. This is a 21.6 increase over output in 1954 of 14,349 tons.

Philippine mineral production in 1956 will exceed 200-million pesos in value, Benjamin Gozon, Mines Director predicts. This will represent an increase of at least 30% over last year's figure of 167,780,000 pesos.

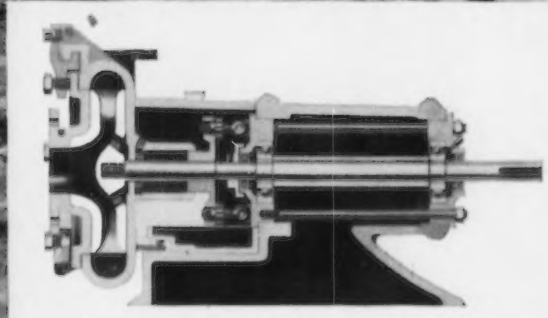
Philippine Iron Mines will increase its output of iron ore by some 500,000 tons yearly, for an added annual value of 8-million pesos, he said.

Mati Iron Mines will go into production this year, tapping an ore reserve estimated at one and a third million tons.

Atlas Consolidated is to increase its daily production of copper ore from 6,000 to 10,000 tons.

Masara Mines will have a full year's production in 1956. During its initial operations for a limited period last year it produced 10,534 tons of gold and copper ore, valued at 243,583 pesos.

Handling TOUGH taconite tailings



Cutaway view of Amsco Pump used for pumping taconite tailings. All wetted parts are HC-250 Alloy.

AMSCO® HC-250 Alloy outlasts previous material 4 to 1

On the Iron Range at a Minnesota plant handling taconite tailings, a 6″ Amsco Pump was equipped with complete HC-250 water ends and HC-250 impeller.

In this highly abrasive pumping application, the HC-250 water ends have given over 4,500 wear-hours. The impeller is outlasting the previous alloy material 4 to 1.

HC-250 is a special, high-chromium alloy perfected for pump parts in operations where highly abrasive material is being moved. This alloy is not limited to purely abrasive problems; it also has excellent resistance to rust, corrosion and impact.

To get extra efficiency from your pumping operations, ask your Amsco Pump specialist for data on HC-250. He will analyze your requirements and recommend the type of Amsco Pump—and material for wear-parts—best suited for your application.

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American Manganese Steel Division · Chicago Heights, Ill.

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Philippines *(Continued)*

Palawan Mercury, which started operations last August, reached capacity production in December and can now produce 15,200 lb of mercury a month.

IN AUSTRALIA

Australian production of crocidolite at Wittenoom, Western Australia, exceeded 4,500 tons in 1955. As Australian consumers prefer the imported amosite, most of the produced crocidolite was exported. Australian exports in 1955 were approximately 7,000 tons, the difference between production and sales being drawn from accumulated stocks. Operating company at Wittenoom (Australian Blue Asbestos Ltd.) recently announced that 1956 sales will be at a similar level to 1955 and that production will be increased to meet the sales target.

Australian production of zinc concentrate for the first three quarters of 1955 was 376,000 tons or slightly more than in the comparable period of 1954. Reports are that practically all expansion plans have now been completed and the output will remain at roughly the same level for some considerable time to come. The 1955 output of refined zinc at Risdon, Tasmania was 100,000 tons and exportable surplus was somewhat less than in 1954. Lack of shipping space has affected the exports of zinc concentrate and of refined zinc.

Sharp reduction in mica mining activities on the Harts Range-Plenty River field has led to an appreciable fall in Australian mica production in 1955. Miners were reported to be transferring to steadier work under more attractive conditions. Commonwealth Mica Pool purchases of mica in 1955 were estimated to amount to 60,235 lb as against 85,518 lb in 1954.

Profit of King Island Scheelite Ltd. in its last fiscal year jumped by £A361,992 to a record £A1,014,661 after tax of £A249,335 (prev. £A264,722). New plant and development appropriation was determined at £A250,000. Ore milled totalled 262,404 dry tons (previous figure was 181,143 tons). Production for the year was 1394.28 tons of scheelite concentrates against previous 1146.8 tons. Ore reserves have been reestimated at 2,970,000 tons compared with 3,164,000 tons 12 months earlier.

Final 1955 mine production figures for lead were about 285,000 tons or about the same as in 1954. Until further expansion programs are undertaken, it is highly unlikely that an appreciable increase in Australian production could be recorded. Refined lead production for the year was about 10,000 tons below 1954 figures but exports of lead concentrates have increased.

No final figures for 1955 are yet available for the production of beryllium but it is certain that the 1954 figure of 148.6 tons has been exceeded. Total Australian output is purchased for the British Ministry of Supply at £A15 per unit, minimum 9.5% BeO delivered Sydney (less agent's commission of 6%). The price remains unchanged since June 1, 1952.

Copper has been found in association with uranium at the Rum Jungle mine in Northern Territory and some of it has been mined and treated. Quantities have been also sent to Port Kemble for testing and treatment. Australian Government circles expressed an opinion that the discovery could make an extra contribution to the profitability of the Rum Jungle project.

Mt. Isa Mines Ltd., an Australian associate of American Smelting & Refining Co., has been granted a new authority to prospect for copper. The authority is for an area of approximately 4.7 sq miles adjoining the company's special mineral lease at Mt. Isa. The company's decision on the proposed construction of copper smelting works at Stuart, Queensland, has not yet been made public.

Northern Hercules N. L. reports the drive on the No. 3 shoot on the 200-ft level was extended 26 ft north to 622 ft in ore averaging 41.3 dwt a ton over 54 in. and 10 ft south averaging 32.5 dwt a ton over 40 in. Mill operations in last four weeks (213 hours) resulted in the treatment of 930 tons of ore and developmental material of an average head grade

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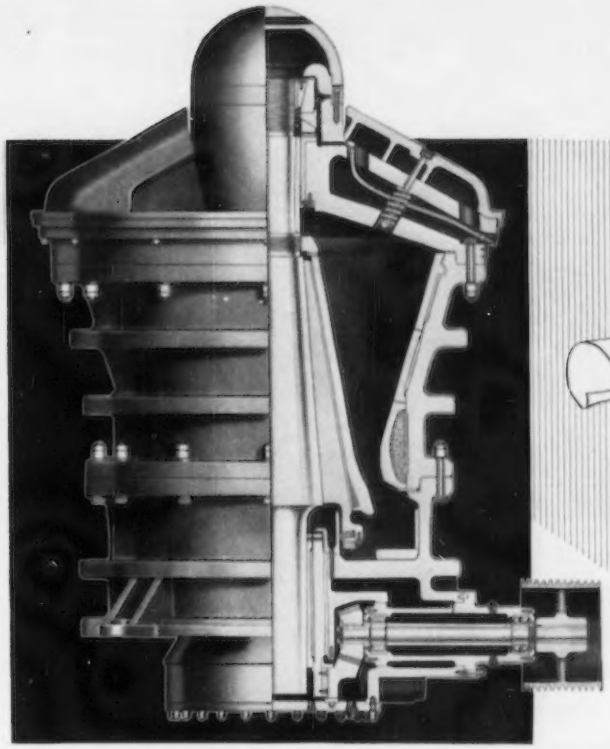

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For complete information, see your A-C representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 07B7870. A-4989

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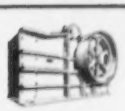
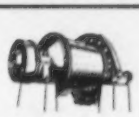
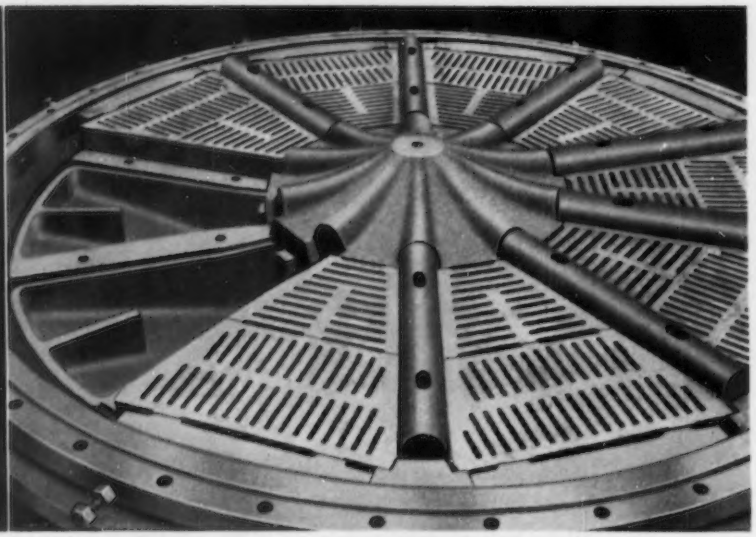

Jaw Crushers

Gyratory Crushers


Grinding Mills

Kilns, Coolers, Dryers

how MARCY *Experience* gives you better-built grate discharge mills



After years of research in the field of grinding Mine & Smelter made the first ball mill in 1915, incorporating the Marcy full-grate discharge. Refinements in design and construction, which can come only from *experience*, have continually improved both the mechanical and metallurgical performance of the Marcy Grate Discharge Mills. This *experience* by M&S has resulted in production of Marcy Grate Discharge Mills which, by actual operating data, have proved their ability to have up to 50% greater capacity than other type mills.

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- **Discharge head has deep chamber** . . . results in unrestricted discharge of material.
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- **Design of slots in grate minimizes plugging.**
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- **Meehanite Metal is used for mill heads** . . . its uniform density, high tensile strength, fatigue strength, rigidity and impact strength provide qualities of toughness and resilience.
- **All grate discharge parts will pass through the manhole** and are easily installed.

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Australia *(Continued)*

of 15.4 dwt ton. Tailings were 4.7 dwt ton.

Rich gold values were again reported by Australian Development N. L. of Tennant Creek. 52.7 dwt was reported for 16½ ft in the west drive off No. 2 crosscut at the 101-ft level of No. 2 shaft. In the main shaft, 183-ft level, the west drive off No. 3 north crosscut encountered values to 37.3 dwt for 23 ft to 54 ft. Values up to 24.5 dwt were met for 7 ft in the east drive, 305-ft level.

Ministry of National Development has welcomed the considerable increase in Australian production of rutile in 1955. Experts agree that a further substantial increase in output will take place in 1956 and in 1957. Several new companies are preparing to start production with U. S. interests becoming more anxious to participate.

Silver Valley Uranium Mines N. L. has taken over a rutile area of 385 acres south of Evans Head on the north coast of New South Wales. So far 3,600 ft of boring has proved 25,000 tons of heavy minerals estimated to contain 7,000 tons of rutile. Boring operations are being continued.

Mt. Magnet Development N. L. reports that the encouraging values in the crosscut to the winze location on the 400-ft level have been opened up showing a well defined quartz mineralization which averaged 66 dwt over 25 ft. A rise in the back of the main winze chamber on this level has intercepted a quartz formation containing free gold. Extent of this formation has not yet been determined.

Standard Mining Corp. reports at the Taree Option, in the Red Head Beach section near Wallabi Point, test drilling so far has blocked out mineral beds with an average thickness of 4.64 ft, showing a heavy minerals content of 32,680 tons, of which 10,457 tons are rutile, with substantial values of zircon, monazite, and ilmenite making up the balance.

IN AFRICA

Corundum-sillimanite deposits are being investigated in Southwest Africa. Present production goes entirely to the refractories industry, but suggestions have been made to separate the minerals and market them commercially. Ore also contains some titanium dioxide as rutile and ilmenite.

Gold and uranium production is expected by mid-year at Vaal Reefs, Klerksdorp district, where test drilling is under way now. Nearly 120,000 ft of development was completed last year, of which over 20,000 was on reefs. Some 85.9% of 17,120 ft sampled proved payable, averaging 92.40 dwt over an average width of 6.45 in., equal to 596-in.-dwt.

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One of the 6 dredges offered. Digging depths range from 35' to 80' below water level; buckets from 8½ to 18 cu. ft.

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Africa *(Continued)*

mineral occurrences, chiefly copper, running west from Lusaka towards Angalo, according to Raymond Brooks, the American mining engineer who found Northern Rhodesia's first payable copper ore at Nchanga in 1924.

Mr. Brooks has returned to the Copperbelt to prospect a new sector in the southwest of the area for an independent U. S. undertaking.

Messina (Tvl.) Development Co. has proved, indicated and probable ore reserves of 82-million tons high grade Fe "with another 80-million classed as possible" in the deposit at Bukwe, Southern Rhodesia. The major Transvaal copper producer is reported planning to take over the state-owned Southern Rhodesia steel works with Lancashire Steel Corp. of England.

New Consolidated Gold Fields has begun a three-year survey of Central Angoniland, Nyasaland. Mineral search will cover some 5,000 sq miles.

Lithium production in the Bikita area topped 80,000 tons in 1955, with a value of approximately $915,000. A $3-million development plan is going into operation to boost production to 90,000 tons per year, but the main obstacle seems to be inadequacy of railways to move the increased tonnage.

First new Copperbelt mine in 25 years is due at Chibuluma, where Rhodesian Selection Trust's $17-million operation will move toward capacity production of 16,000 tons copper and 500,000 lb cobalt per year. Processing will take place at the refinery being constructed at Ndola.

Northern Rhodesia manganese is under development by Rhodesian Vanadium Co., which will send 300 to 400 tons per month to Mufulira for treatment and shipment to U. S. markets.

Cost of boosting capacity at Ndola electrolytic copper refinery is set at about $4-million. Output will be stepped up from 82,696 long tons (1955) to about 110,000 per year. Initial capacity production is scheduled for 1958, with full rate due in 1960. Roan Antelope mines is a two-thirds shareholder; formerly supplied 60,000 tons per year. It will now direct total output to the new facility.

Merriespruit G.M., Orange Free State, began production, bringing the total producing gold mines in the area to eleven. Merriespruit, in which Kennecott Copper is reported to hold an interest, set the record for new mines by crushing 75,000 tons during the first month of operation.

West Driefontein mine recovered some 18 dwt per ton in March, a new production record. Earnings are expected to improve even more at mid-year, when uranium recovery will commence.

A new world record for hard rock tunneling was set at Doornfontein G.M. on the West Wits line when 1508 ft were accomplished in 26 consecutive working shifts. The previous record was set in May last year with 1394 ft in the same time. New record was set in a crosscut

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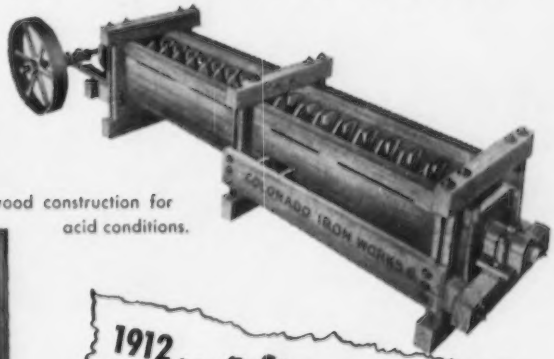
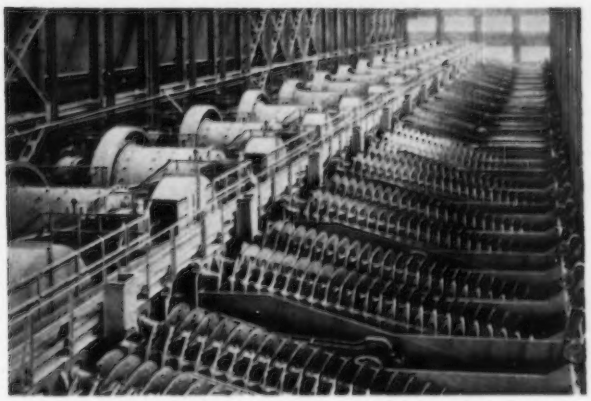


Photos show typical early models of the Akins, including one of wood construction for acid conditions.



1956 Photo shows part of present installation in large copper company operation... within a few miles of the same location where the first Akins was used by Shannon Copper Co. This company, since 1918, has used a total of 116 Akins Classifiers and 114 Marcy Mills in its various plants.

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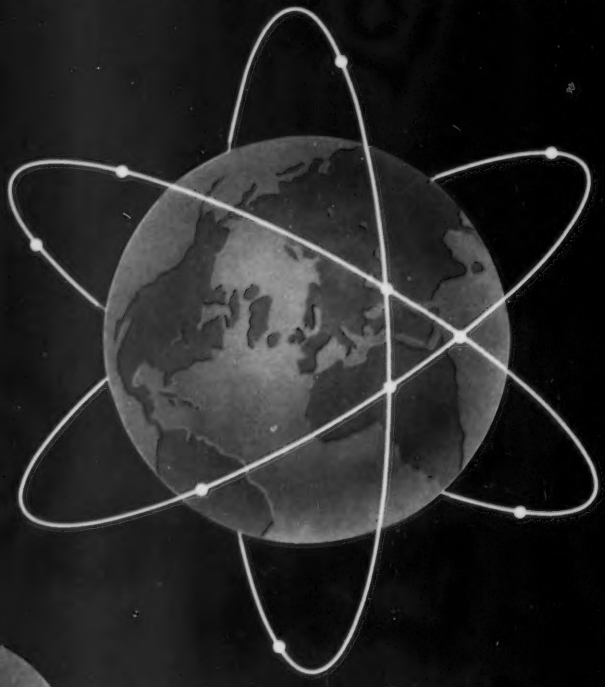

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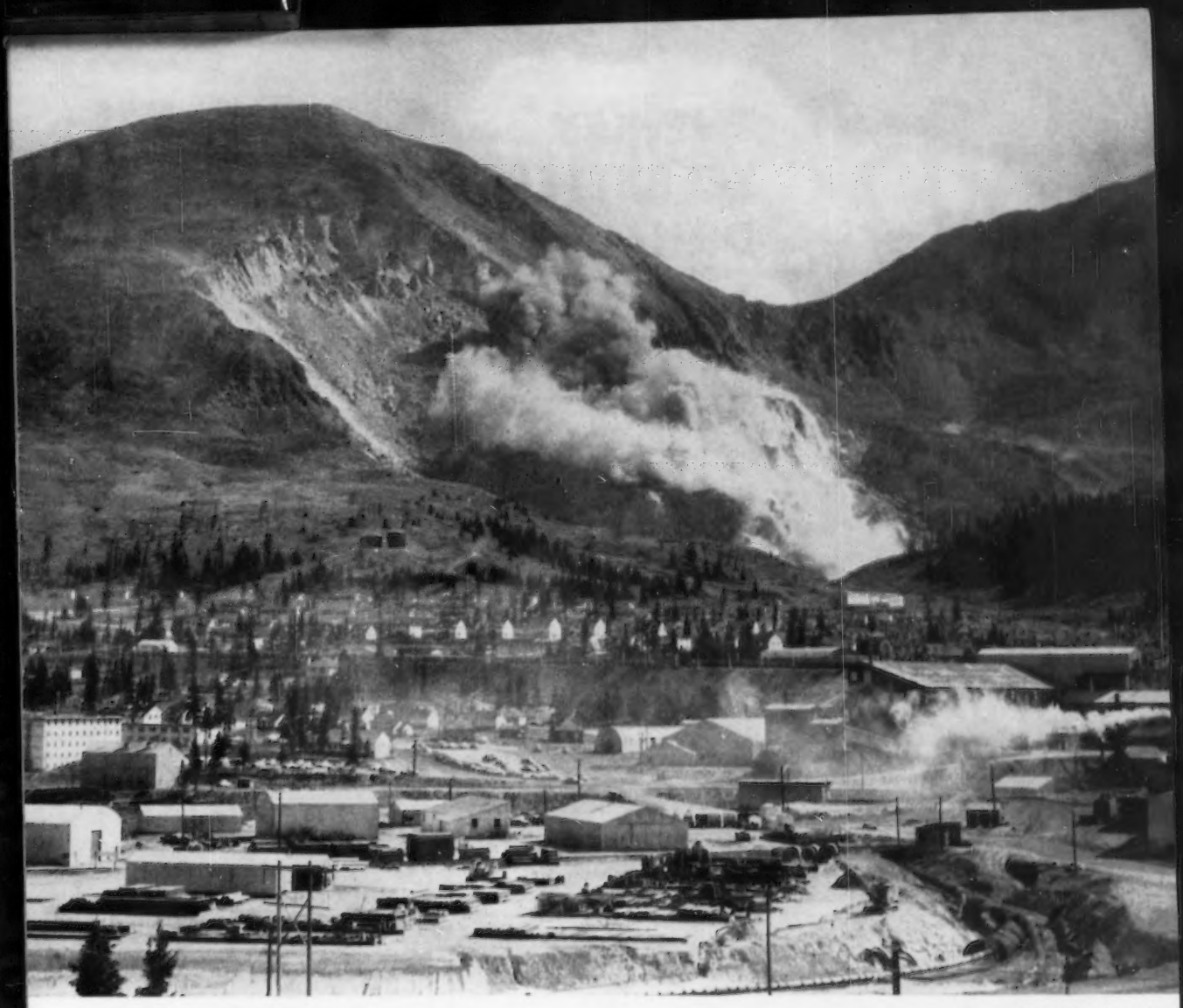

(Courtesy Climax Molybdenum Co.)

Single blast of Du Pont "NITRAMON"® breaks 750,000 tons of ore at Climax, Colorado

On October 2, 1955, the Climax Molybdenum Co. brought down an estimated 750,000 tons of ore at its Climax, Col., mine when it collapsed a section of huge arch that had resisted earlier blasting efforts. 81,614 pounds of Du Pont "Nitramon"—the safest blasting agent known—were loaded in three coyote adits.

Climax uses "Nitramon" in mammoth blasts like this because its combination of maximum safety and power is ideal for coyote work. With "Nitramon," crews can safely use electric lighting to speed loading. And they needn't worry about headaches—"Nitramon" contains no nitroglycerin.

"Nitramon" cannot be exploded by shock, friction or rifle bullets. It should be detonated with a special insensitive "Nitramon" Primer, which must be initiated with "Primacord."

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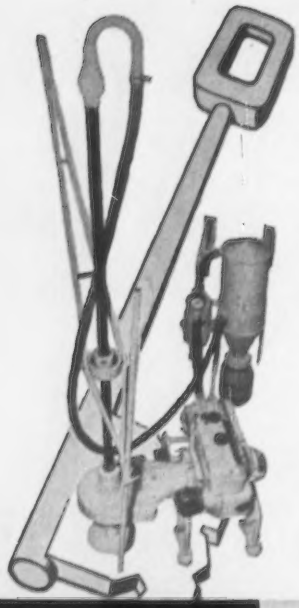

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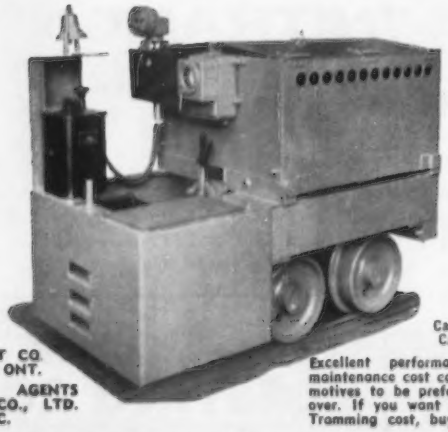

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1140 IVANHOE ROAD CLEVELAND 10, OHIO, U. S. A.

Africa *(Continued)*

10x10 ft at a depth of 5,850 ft towards the position of a new subvertical shaft.

No special equipment was used. Cycle of operations in minutes was: Cleaning, 75; drilling, 55; face examination, 10; charge up and blast, 10; and re-entry, 30. Total—180 minutes. Cleaning was carried out with a standard 21 Eimco loader, periodic exchange with a standby loader was undertaken for servicing. Loading was into 4-ton Granby cars in trains of six or seven. Exchange of full and empty cars at the face was done on a traverser approximately 50 ft from the face. Six standard Delfos jack hammers 2⅝ in. mounted on airlegs operated from a drilling program, drilled a 34 hole draground to give an advance of 6 ft per blast. Drill steel was 1 in. hex with tungsten carbide-tipped drilling head of chisel type and 9 ft long. Four pilot holes were drilled to 12 ft 6 in. in every round as protection against intersection of unknown water fissures. Over-all protective cover was provided by diamond drill holes to 610 ft in advance of the end at intervals of 400 ft, giving a minimum protection of 140 ft.

Compagnie Miniere de L'Ogoce will undertake exploitation of manganese deposits at Franceville, Equatorial Africa. Firm, which is one-half owned by U. S. Steel, applied for a permit to mine Mn and Fe ore.

IN ASIA

INDIA

A Canadian-backed aluminum factory with an estimated annual capacity of 10,000 tons will go into production at Krakud, in Orissa, in the middle of next year, the Minister for Commerce, has announced in Parliament. He said the factory would be supplied with 25,000 kw of electricity from the Kirakud Dam project by next year and production would start as soon as power was available.

The factory will be the biggest aluminum producing unit in India and will double the country's aluminum production. It is being established with assistance from Aluminium Ltd. of Montreal.

It is understood that the Soviet Union has also offered to help India develop her aluminum industry.

CHINA

Searches for mineral deposits have been started on a large scale in the vast areas of north-west China by more than 6,000 geological prospectors, according to the New China News Agency. They will work over an area totaling a quarter of a million square km.

Volume of prospecting work in the Kiuchuan Basin, where the Yumen oilfield, China's biggest oil producing center, is located, will be more than double that of last year.

Why this feeder doesn't cave in

● The reason is simply this: *The* PIONEER-ORO *Feeder is the most rugged feeder ever built.*

Take a look at its massive pans . . . cast from a special wear-resistant manganese steel, heavily ribbed, reinforced, and all the way from 3/16" to 1" thick, depending on width of feeder. The pans are supported by heavy, closely-spaced manganese steel rollers, keyed 3 to a heavy diameter shaft. Each shaft turns in 3 heavy-duty bearings rigidly supported on the feeder frame.

Takes heaviest dump loads

The PIONEER-ORO is designed for the roughest, toughest feeding jobs on earth. It withstands the impact of the heaviest dump loads. It shrugs off abrasion from hard ores, slag, flintrock, granite, and other coarse, heavy materials.

But the mighty PIONEER-ORO offers more than sheer, brute strength. It is a smooth-running, finely engineered unit designed to deliver a constant flow of heavy, abrasive material, with a minimum of maintenance. Even preventive maintenance costs are low.

Rivetless pans overlap and interlock

Pans, for example, overlap and interlock to provide added stability and stop leakage and spilling. Upturned end flanges also reduce loss of material. Drive links are cast as an integral part of the pan, so there are *no bolts or rivets that can loosen*. Easily replaced link bushings need no lubrication.

Sprocket teeth are readily reversed or replaced without taking the sprocket hub from the shaft or even disconnecting the pans. Like all other wearing parts, these teeth are cast from special wear-resistant manganese alloyed steel.

Supporting rollers and shafts can be removed, too, without disturbing the pans.

OTHER FEATURES

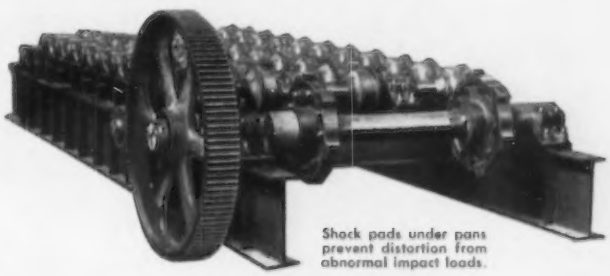
1. Patented lugs in pan links remove dirt, make links self-cleaning.
2. Feeder can be made to run in either forward or reverse direction.
3. Available in standard widths up to 84", widths in excess of 84" by special order, and lengths as required.
4. Made with 6", 9", 12" or 15" pan pitch (depending on width) to fit available head room.

PIONEER-ORO FEEDER
Capacities in tons per hour

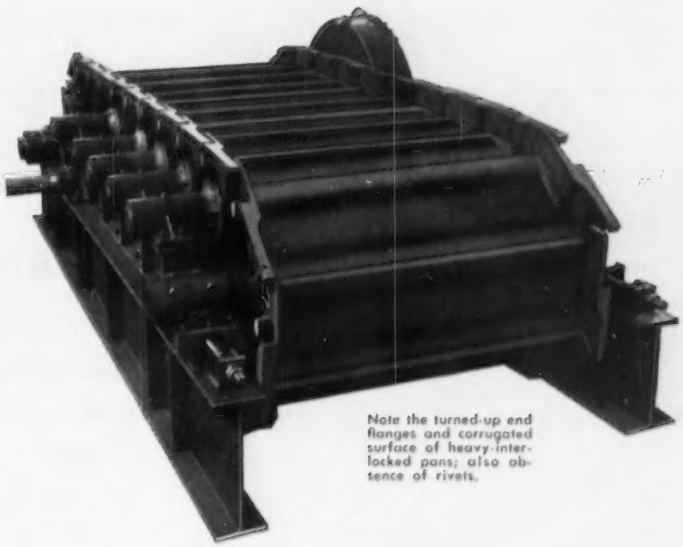
Travel per Min.	Width of feeder						
	30"	36"	42"	48"	60"	72"	84"
10'	74	108	147	192	300	432	588
15'	112	162	222	289	450	648	888
20'	148	216	294	384	600	864	1176
25'	186	270	368	482	750	1080	1472
30'	223	324	442	577	900	1296	1768

Ask Your Feeder Salesman These Questions

1. Are pans made from special manganese steel? How thick?
2. Are pans and links cast together so they are rivetless?
3. Can manganese parts be replaced without disassembling pans?
4. Are rollers keyed to shafts which turn in heavy bearings?



Shock pads under pans prevent distortion from abnormal impact loads.



Note the turned-up end flanges and corrugated surface of heavy-interlocked pans; also absence of rivets.

For further details and specifications regarding full line of PIONEER *Feeders, write Pioneer Engineering Works, Inc., Minneapolis 13, Minn. (subsidiary of Poor & Company, Chicago) or see your nearest* PIONEER *Distributor.*

BUY BOTH! HIGHER OUTPUT LOWER UPKEEP

Pioneer *Continuflo* EQUIPMENT

Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis 13, Minn.
Subsidiary of Poor & Company • Chicago
Please send information on equipment checked.

- ☐ GRAVEL PLANTS
- ☐ WASHING PLANTS
- ☐ MECHANICAL FEEDERS
- ☐ ROCK PLANTS
- ☐ BITUMINOUS PLANTS
- ☐ VIBRATING SCREENS
- ☐ JAW CRUSHERS
- ☐ APRON FEEDERS
- ☐ BUZZER SCREENS (LIGHT DUTY)
- ☐ ROLL CRUSHERS
- ☐ ORO FEEDERS
- ☐ CONTINUFLO CONVEYORS

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Company_____
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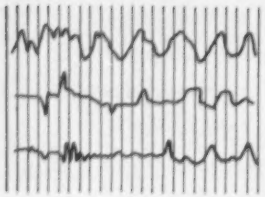
NOW- SIMPLE METHOD FOR RECORDING VIBRATIONS

Generated by blasting and industrial operations



Record of quarry blast.

PERMANENT RECORDS

PORTABLE BLAST and VIBRATION SEISMOGRAPH

This instrument can be set up, levelled, and made ready to operate in a few minutes at any reasonable level location—indoors or out. Vibrations are recorded photographically. Easy to operate. Powered from enclosed standard dry cells.

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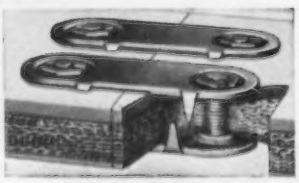
- ★ Trough naturally, operate smoothly through take-up pulleys.
- ★ Distribute pull or tension uniformly.
- ★ Made of Steel, Monel, Stainless, Everdur. Also Promal top plates.
- ★ FLEXCO Rip Plates are for bridging soft spots and FLEXCO Fasteners for patching or joining clean straight rips.



Compression Grip distributes strain over whole plate area

Order From Your Supply House. Ask for Bulletin F-112

FLEXIBLE STEEL LACING CO., 4635 Lexington St., Chicago 44, Ill.

China *(Continued)*

Geologists have left north-west China for the Nagchuka area in northern Tibet to investigate prospects for oil and other mineral deposits, the Agency added.

Annual Reports *(from p 126)*

Vitro Corp. of America showed a net profit after taxes of $437,856, put the emphasis on expansion for 1955. The company acquired 45% interest in Thieblot Aircraft Co., Inc., 100% of Refinery Engineering Co. (U. S. and Canadian branches), an interest in Sheer-Korman Associates, Inc., (a research group working on boiling extraction of metals from ore), a 40% interest in Heavy Minerals Co. Heavy Minerals is a joint venture with Crane Co. and Societe de Produits Chimique des Terres Rares. The group has a dredging plant for rare earths at Aiken, S. C. and plans another at Panama City, Fla. At Chattanooga, Tenn., Vitro Corp. built an uranium-thorium, misch metal and rare earth production plant. Vitro Uranium, subsidiary, developed solvent extraction in pilot plant stage, plans commercial mill on the results; also agreed to take Hidden Splendor ore. Rare Metals branch of Vitro has developed solvent extraction process to separate uranium-cobalt-nickel residues.

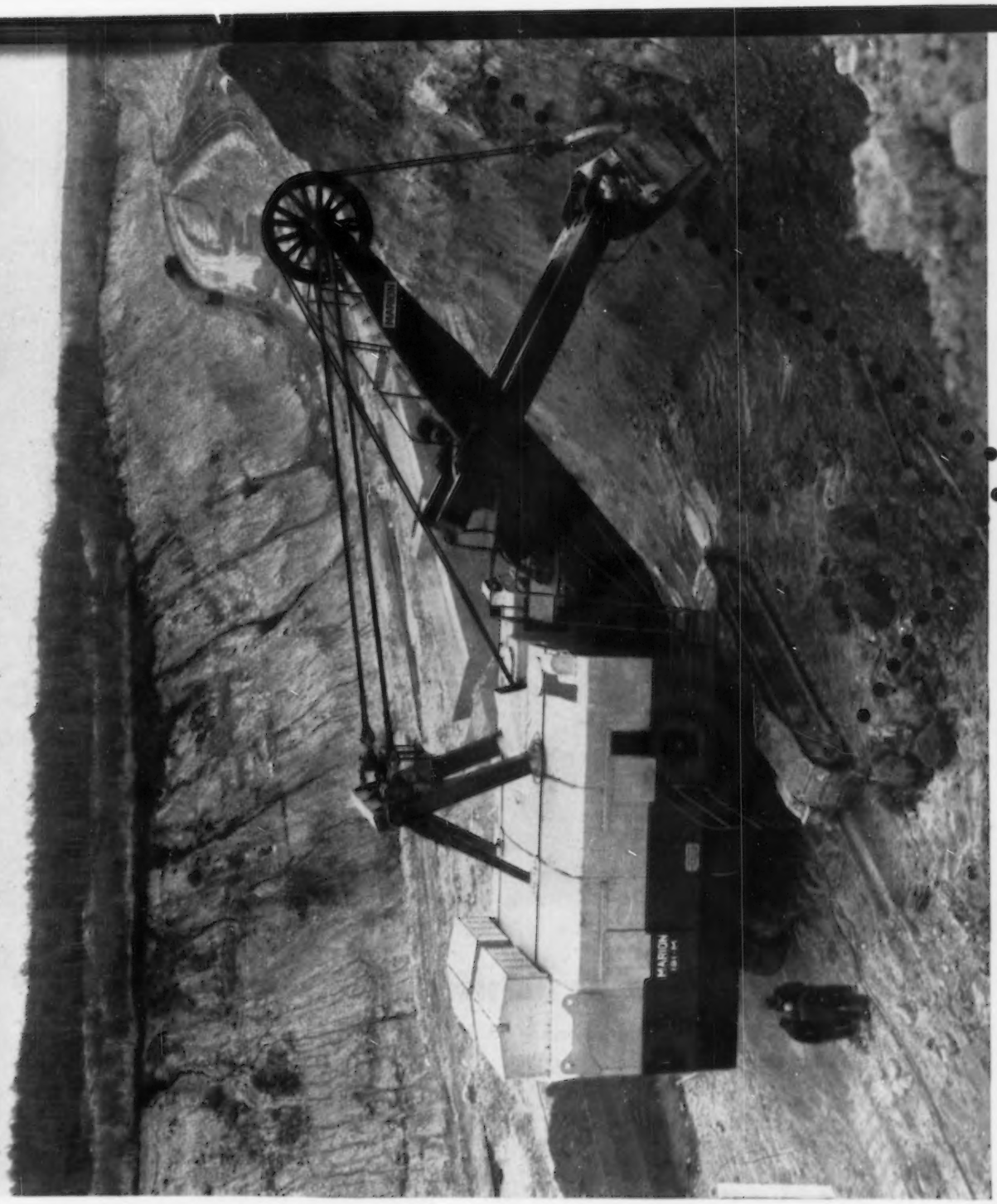
Aluminium Ltd.'s primary aluminum output increased to 607,000 short tons in 1955, according to company annual report. About one third of this production went to U. S. customers. Net income was $48,193,952. Aluminum Co. of Canada, Ltd. earned $41,160,799 of parent company's total net. Capital expenditures in 1955 were $71-million.

During the year, the company authorized successive increments of expansion of primary aluminum production facilities. Construction will stretch over 1956 to 1959. Approximately $180-million will be spent at Kitimat and $55-million on related bauxite and alumina facilities.

In current expansion phase, an additional 22,000 tons capacity is being added to Isle Maligne, Quebec smelter. Project will be completed by July, bringing company's total Quebec smelter capacity to 582,000 tons.

At Kitimat, plans are for smelter capacity to reach 330,000 tons by 1960. Of this new capacity 180,000 tons will be on stream by year end. By 1959, power generation capacity at Kemano will reach 1-2 million hp; equal to Saguenay.

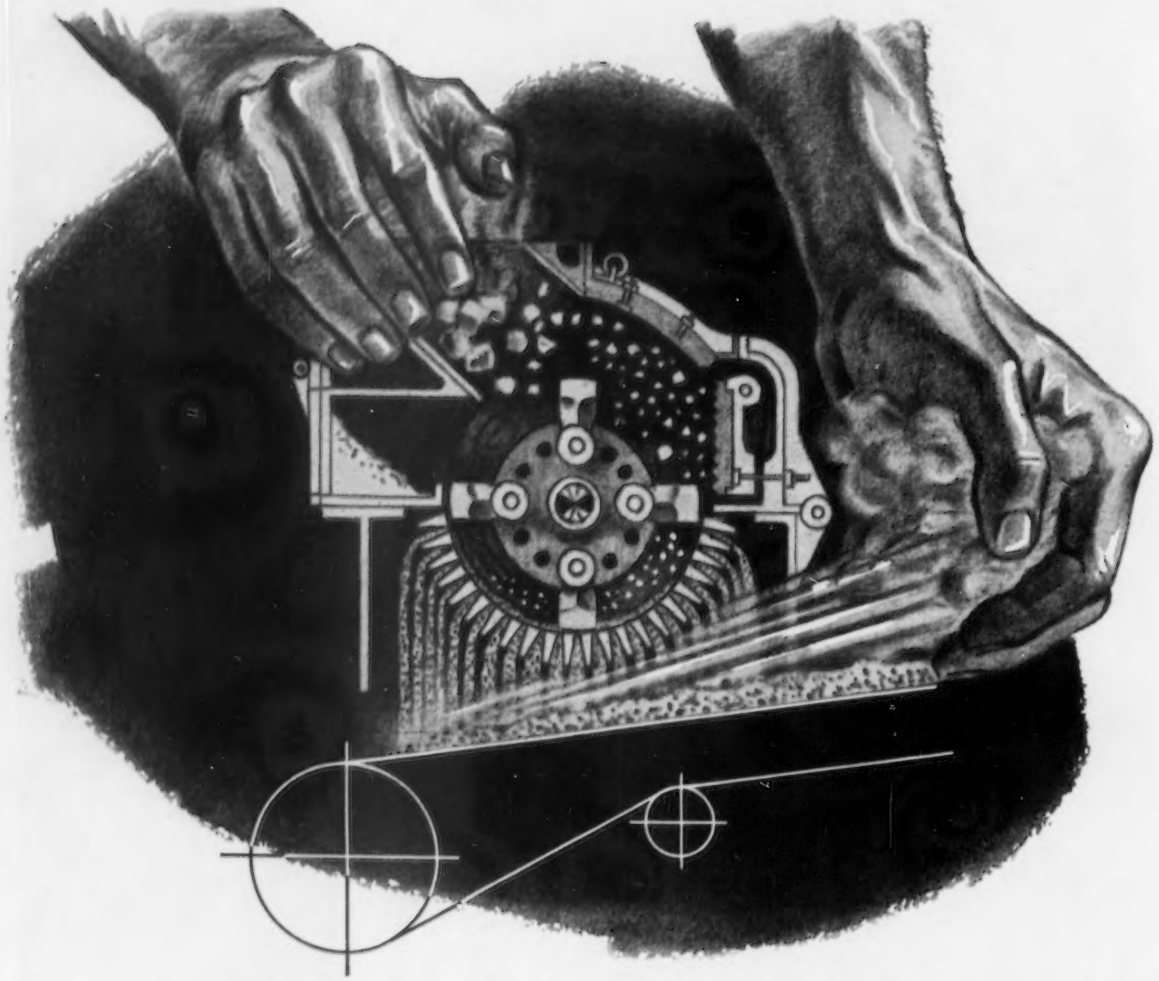
New York & Honduras Rosario Mining Co. reported a net income of $808,109. El Mochito mine capacity was raised to 160 tpd. New roasting plant has capacity of 190 tpd. The 11,000 ft Raices tunnel was started to connect with new ore. Ore reserves were 263,618 tons, 3 oz silver plus gold, lead and zinc. Company has option on 159 claims near Chibougamau and started diamond drilling. Option was taken on manganese property in Panama. In Honduras, San Felix Copper option is being drilled. Syndicate, headed by this company is building a copper-leaching pilot plant at Sagasca,



BIGGEST DIGGER ON TWO CRAWLERS

The 10 yard dipper of this big digger is impressive, for the MARION 191-M is the world's largest loading shovel on two crawlers. Equally important on the iron range is the fast, small-machine cycle time that converts mountains into rail car loads in jig time.

MARION POWER SHOVEL COMPANY • MARION, OHIO



AAF Takes Crushing Dust in Hand

AAF Dust Control equipment has been a vital working partner in crushing operations for more than a quarter of a century.

Today, thousands of crushers—whether hammermill, jaw, mill, impact breaker, gyratory, or what have you—are depending on AAF for effective dust control. Results: employees are more efficient, maintenance costs drop, and dollars are saved through reclamation of valuable material.

AAF's experience penetrates every industry, includes every type of dust. This reflects in the complete product line which includes dynamic precipitators, hydro-static precipitators, dry centrifugals and fabric arresters. For practical help with *your* dust problem, call your local AAF representative or write us direct.

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BETTER AIR IS OUR BUSINESS

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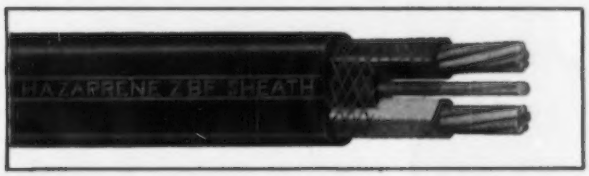
tonic for a tired shuttle car

The shuttle car is just about the hardest working machine in a coal mine. It's a glutton for punishment and for cable, too. The fate it hands out to cable is cruel—a succession of run-overs and almost constant abrasion. But, tough as a shuttle car is, there is nothing more "beat" than one that's suffering from beat-up cable.

It's different, however, with Hazacord Red Saddle Hex-Tite Shuttle Car Cable on the job. Hazacord's Hex-Tite design prevents internal slipping and rotation, forms a solid locked-tight construction that makes Hazacord the match for any shuttle car. And the Red Saddle pre-formed protective wall of neoprene assures a uniform fill between conductors . . . positive protection against short-circuiting due to run-overs.

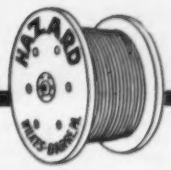


Hexagonal insulation provides six plane surfaces to lock with the Hazaprene ZBF sheath and bonded Red Saddle, preventing internal slipping and rotation. Heavy reinforcing cords, embedded in both insulation and sheath, are an additional guard against pulling and a special adhesive completes the bonded construction.

Hazacord's heat-resistant insulation, bonded to the extra-flexible conductor, permits high operating temperatures. The Hazaprene ZBF sheath is cured under pressure in a continuous metal mold to assure: *1. optimum vulcanization; 2. maximum density; 3. lasting toughness; 4. smooth, wear-resisting surface; 5. resistance to mechanical abuse; 6. controlled diameter.*

Hazaprene sheaths are flexible and unaffected by oils, acids, alkalies and mine water.

Write for Bulletin H-450, the Hazard Mining Cable Catalog, for information on the cables that are a match for any shuttle car. Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.



HAZACORD

mold-cured portable cables

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Specialists in Wet Gravity Ore Recovery, Sizing and Separating Equipment . . . since 1912

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Annual Reports *(Continued)*

Chile. Successful pilot plant will mean a mine and mill.

Dome Mines Ltd. produced 170,620 oz gold, had a net income of $1,814,214 for 1955. Mine and mill handled 711,800 tons. Reserves at year end were 2,498,000 tons. Total production costs were $31 per oz. Ore reserves at Sigma Mines (Quebec) Ltd. are 1,460,500 tons, 4.48 dwt. gold. Reserves at Campbell Red Lake Mines Ltd. were 956,000 tons, 12.1 dwt gold. Mindamar Metals Corp. Ltd. showed net profit for the year, as against net loss last year. Ore reserves were set at 86,740 tons. No new ore was developed. Ore will be exhausted by end of April.

Foote Mineral Co. completed expansion of lithium units at Kings Mt. and Sunbright, started action on taking over Electro Manganese Corp., and showed a net income of $902,841, according to board chairman, Gordon H. Chambers.

Climax Molybdenum Co. mined and milled 9,227,000 tons, produced 43,043,138 lb molybdenum during 1955. Net profit for the year was $17,424,114. Annual report stated that Free World demand during 1956 will reach 60-million lb moly. Ore reserves were set at 330,-million tons. Mill capacity is 30,000 tpd. New mill unit of 3,500 tpd is being added at Climax to bring this 30,000 up to 33,500 tpd. At Langeloth, Pa. oxide plant capacity was doubled. Climax Uranium Co., Grand Junction completed plant expansion started in 1954.

Climax explored and found one reasonably high grade uranium deposit in Kendrick Bay, Alaska. Climax disposed of all thorium holdings.

King Island Scheelite Ltd. mined and milled 262,405 tons, 0.5% WO_3, produced 1,394 tons, 66.4% WO_3 concentrate from their open pit mine. Reserves were set at 2,970,000 ton, 0.48% WO_3. Net income was £1,014,661.

MacLeod-Cockshutt Gold Mines Ltd. mined and milled 600,810 tons, produced a net income of $511,190 from gold and silver revenue. Reserves were 1,800,000 tons, 0.14 oz gold.

Noranda Mines Ltd. reported Horne mine ore reserves at 12,254,000 tons, 2.3% Cu and 0.187 oz gold. This total does not include ore at Chadbourne and No. 5 zone at Horne, where about 3,370,000 tons are estimated to be on hand.

Bunker Hill Co. purchased all the outstanding stock of Sullivan Mining Co. and dissolved that company, according to annual report. Net income for 1955 was $3,323,219. At Bunker Hill ore reserves were 2,809,203 tons after milling 528,834 tons this year. At Crescent 80,960 oz silver were recovered. Star had 1,476,340 tons reserves at year end. Production at the lead smelter and the electrolytic zinc plant were at capacity.

Pend Oreille Mines mined and milled 503,391 tons. Costs went up to $2.86 per ton.

United States Smelting, Refining & Mining Co. ended the year with a net profit of $4,497,138, according to company annual report for 1955. U. S. and Lark Mine, Utah ore production was about the same in grade and tonnage as 1954 figure. Long term leases were obtained on 850 acres next to company holdings in Bingham district and development work will be undertaken.

Midvale plant operated without interruption. U. S. S. Lead Refinery, Inc. underwent an expansion program that is to be complet this summer. Mining leases on two claims were granted at the Bayard, N. M. property. Production from these two leases will be milled by the company at Bayard.

Company had five dredges operating at Fairbanks and two at Nome. Plans for 1956 call for six at Fairbanks and two at Nome.

A 30-yr agreement with Canadian Pipelines & Petroleums Ltd. transferred to USSR&M the oil, gas and mineral rights to all Pipelines property, held or acquired during the agreement, in Saskatchewan, excluding certain uranium claims in Beaverlodge area.

It's MineVent Flexible Ventilation Tubing -- Of Course!
THIS 36" dia. MineVent Tubing with patented Snap-on Coupling and Type B Hangers is bringing fresh air to the working face in this non-metallic mineral mine. MineVent is preferred for all underground mining because it is light in weight; abrasion, moisture and corrosion resistant; easier to couple, hang or store. Also, Neolon Tubing has all the qualities of MineVent plus lighter weight and utmost tear resistance. Send for samples and catalog.
A B C
AMERICAN BRATTICE CLOTH CORP.
220 S. BUFFALO STREET, WARSAW, INDIANA

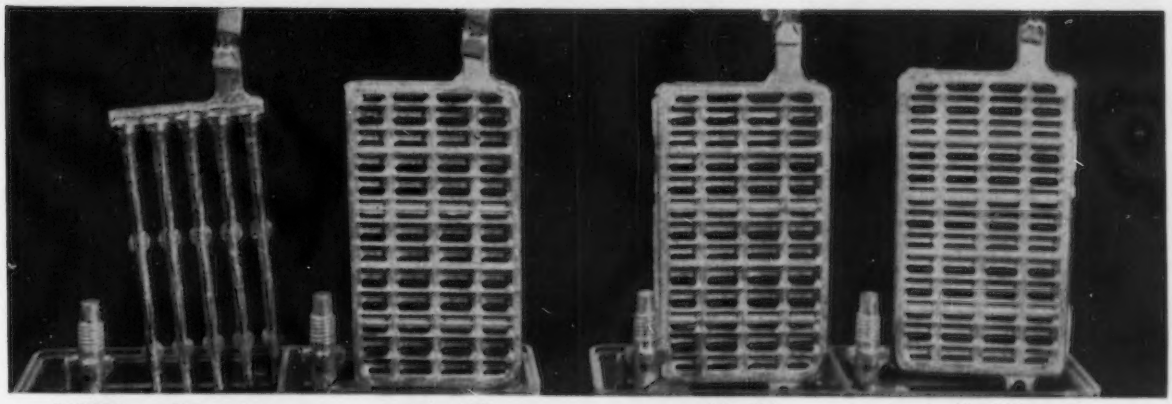
Germanium *(from p 77)*

By way of illustrating the drive toward improvement, consider Bell Telephone Laboratories. Early in 1955 Bell announced a machine called "Mr. Meticulous" which aids in the mass output of transistors. In certain tran-

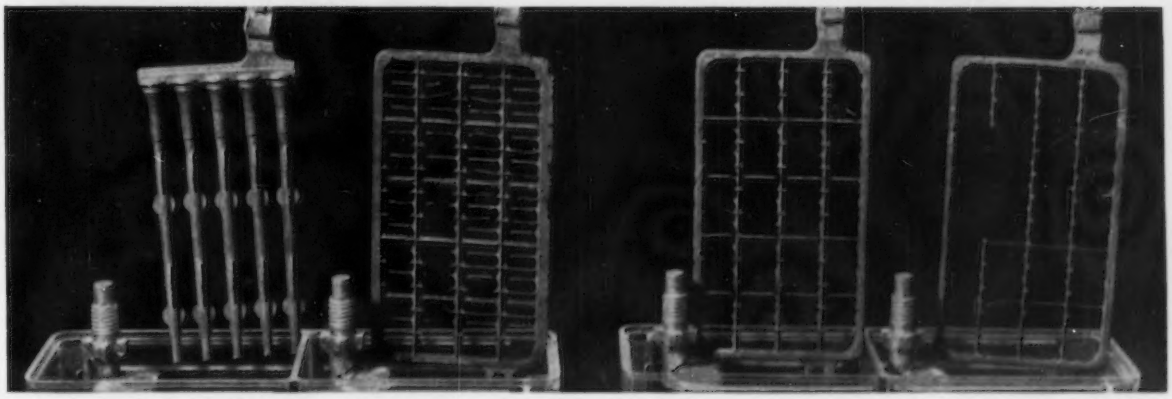
(Continued on page 208)

EXIDE-IRONCLAD BATTERIES

For all mining applications



BEFORE: Silvium alloy — Alloy "A" — Alloy "B" — Alloy "C"



AFTER: Note how the Silvium grid resisted corrosion. Compare it with the other alloys.

Corrosion resistant SILVIUM prolongs battery life

BATTERY FOR MINING LOCOMOTIVE, Model MVM. Specially designed to fit space provided on locomotive. Has tubular construction of positive plates, Silvium grids, "Permanized" negative plates, extra heavy connectors, and all other Exide-Ironclad advantages that mean power to spare in heavy duty applications. Write for Bulletin 5161.

Reaching down deep into every Exide-Ironclad Battery are the fingers of Silvium alloy metal which form the grids of the famous Exide-Ironclad positive plates.

Silvium is a special alloy developed by Exide to resist corrosion and thus prolong battery life. For proof, Exide research engineers compared the performance of an Ironclad Silvium grid side by side with ordinary grids of other lead alloys. As the photographs above show, only Silvium came through the test without damaging corrosion—undiminished in size, unimpaired in strength. The other grids showed from moderate to severe corrosion.

Tests have proved that Silvium is not only more resistant to corrosion, but also a better conductor of electricity. Hence it both prolongs battery life and —because there's less internal battery resistance—more readily permits heavy drafts of power.

This special material is only one of the many exclusive features which have made Exide-Ironclad Batteries world famous for high capacity and long life. When you order batteries for heavy duty applications, or the equipment requiring such batteries, be sure to specify Exide-Ironclad. Write for detailed bulletin. Exide Industrial Division, The Electric Storage Battery Company, Phila. 2, Pa.

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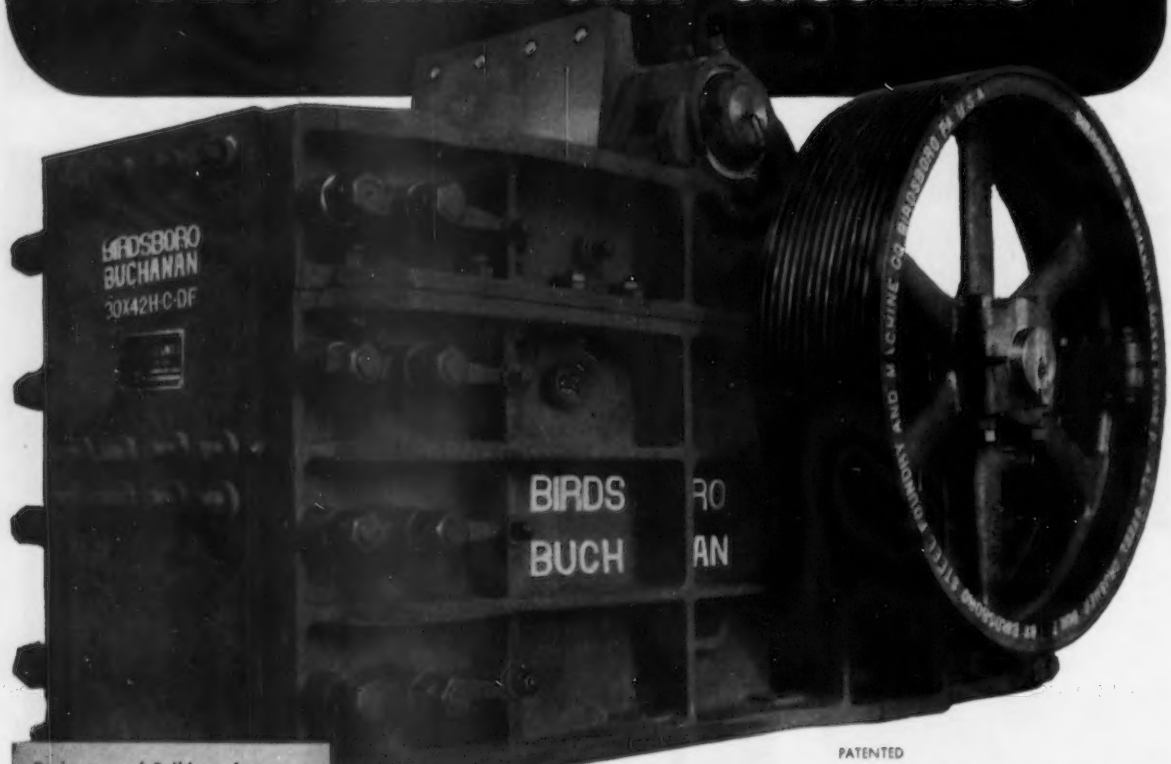
FOR HIGHER TONNAGES

AND LONGER LIFE IN TOUGH SERVICE...

BIRDSBORO - Buchanan

DEEP FRAME JAW CRUSHERS



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ROLLS: Steel, Alloy Iron, Alloy Steel

The high tonnage crushing you get from Birdsboro-Buchanan Jaw Crushers stems directly from the DEEPER Frame and LONGER Swing Jaw. These features provide the DEEP crushing chamber to assure positive nipping action which minimizes slippage and results in a higher ratio of reduction and greater capacity with lower maintenance cost. These features also make possible greatly increased jaw plate, toggle and bearing life.

These all cast steel patented crushers are available in a full range of sizes from 24″ x 36″ to 66″ x 84″, to suit any plant design. For help on your primary crushing problems, get in touch with Birdsboro.

CR 4-55

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BIRDSBORO STEEL FOUNDRY & MACHINE CO., Main Offices in Birdsboro, Pa. District Office: Pittsburgh, Pa.

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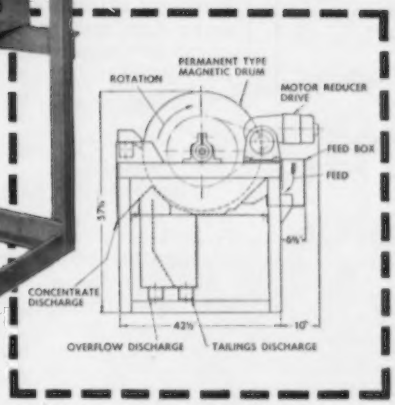


STEARNS ANNOUNCES

new wet-drum magnetic separator for taconite concentration

Here is the Stearns-type WPD Magnetic Separator—a powerful new, wet-drum, permanent magnet unit designed for cobbing and roughing in taconite concentration.

Specially designed magnet not only has a deep, powerful field, but also provides correct flux distribution for positive transport of the collected magnetics to the discharge point. Both of these factors mean highly efficient magnetic recovery for the type WPD Separator.

Designed to Give You Low Cost, Rapid Recovery in Taconite Concentration

Steady Material Flow — Minimum Drum Wear. Separation tank and feeder provide a gravity flow from feed to non-magnetic discharge section — eliminate settling of coarse particles in feed tank. Feeder design keeps wear and abrasion on cylinder at a minimum.

Uniform Feed Distribution across entire drum width through special baffle system further insures high magnetic recoveries.

Concurrent Feed Eliminates Wipers and Wash Spray. Feed flows in same direction as drum rotation so any carry-over on drum is re-introduced to magnetic field. This means no wash spray or wipers are needed.

Single Drum or Individually-Controlled Multi-Drum Units Available. Two- and three-drum separators incorporate repulping boxes for control of feed solids at each transfer point — permit re-cleaning of concentrate when needed. Each drum is driven by a separate motor for positive, individual speed control. Waterproof drum construction.

Low Operating Cost. Horsepower requirements are low, yet plenty of power available when heavy load occurs. Drum turns on anti-friction bearings. Non-magnetic drive components do not attract magnetic particles, thus reducing wear on chains and sprockets. Powerful Alnico permanent magnet requires no external energization, minimum of maintenance.

Utmost Simplicity in Operation and Maintenance. One man can control a large number of units. Separator is easy to disassemble and put together. Removable feeder also simplifies maintenance.

Minimum Floor Space. Compact separator is easily set up and installed.

Write for complete details on this new, efficient type WPD taconite separator.

1146

MAGNETIC EQUIPMENT FOR ALL INDUSTRY

STEARNS MAGNETS

STEARNS MAGNETIC, INC., 624 S. 28th St., Milwaukee 46, Wis.

HAMMOND'S SAFE BLASTING EQUIPMENT

EXPLOSIVE BOXES

These rigid non-conductive explosive boxes represent a prime safety investment. Made entirely of wood-tongue-grooved and dove-tailed construction . . . no metal parts . . . automatic lock . . . rubber band spring . . . moisture-resistant. Box sizes are based on 1¼ x 8" sticks.

WOOD TAMPING POLES

For Tamping Explosive Shots: Poles are round, made of Hardwood. Sizes to 10' long.

SECTIONAL TAMPING POLES

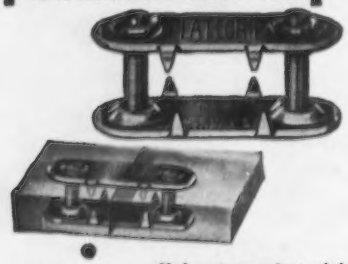
These poles are made of straight grained wood and are coupled together with removable wood pins held in place in recessed grooves by a rubber band and can be quickly connected and unconnected. Couplers and Head Blocks are 4, 5, and 6 inches in diameter. Please specify size when ordering. Poles are 1½" in diameter.

J. V. HAMMOND CO.

Spangler, Pa.—Catalog on Request

PLATEGRIP

PLATE FASTENERS FOR CONVEYOR BELTS



- Make strong dust-tight, water-tight joints in belts of any width. Special design spreads tension uniformly across belt, allow natural troughing of belt and assures smooth operation over flat, crowned or take-up pulleys. Sizes for belts of from ¼" to 1½" thickness. Write for Catalog Sheet.

ARMSTRONG BRAY & CO.

5322 Northwest Highway, CHICAGO 30, U. S. A.

Germanium *(Concluded)*

sistors two wires must be affixed to the middle of the N-P-N sandwich which is about 1/10,000 of an inch thick. The trick is to find the junction, which can now be done by this machine. It then welds the wires to the right spot. If the electrical qualities are not right or if the weld is wrong the transistor is rejected at that point. The aim is to make transistor manufacture completely automatic, which should reduce costs.

Outlook

Concerns among germanium people is that about 20,000 kg was consumed in 1955 out of a total supply of approximately 24,000 kg available.

For 1956, there is some disagreement about projected demand. Highest estimate was 35,000 kg; the lowest, 24,000 kg, about equal to the previous year's supply. A weighted average for the industry as a whole would be something over 30,000 kg.

For 1957 the agreement is a little closer with an estimate of 40,000 to 45,000 kg being required to meet the demand.

For 1965? Guesses range from a 75,000-kg to 100,000 kg business.

Will the supply be adequate? Production may fall a little short in 1956 and even with the estimated 3,000 kg surplus from 1955, germanium is expected to be hard to get for the remainder of the year.

By 1957 African production via Belgian plants should be arriving pretty steadily on the market. This coupled with hinted-at expansion in both Europe and the United States, should be adequate, if barely so. While Tsumeb and Union Miniere can and are thinking in terms of expansion to a combined total of 40,000 kg. capacity by 1959 if demand is satisfactory. limited raw material supplies are likely to hold back expansion in the United States. Refining capacity is no problem, as will be seen in the following article showing the size of a full scale plant, but raw materials are being "scrounged for" even now.

New sources of germanium are being investigated in California and Nova Scotia and several companies are systematically scanning their mines and smelters for germanium in the ores.

Summing up, it appears that the personal observation of one factor in the business, "Adequacy but no surplus", will be the rule for the next few years. Over the long pull, germanium, with its close ties to the tremendously expanding electronics industry, looks like it is in for a prosperous future.

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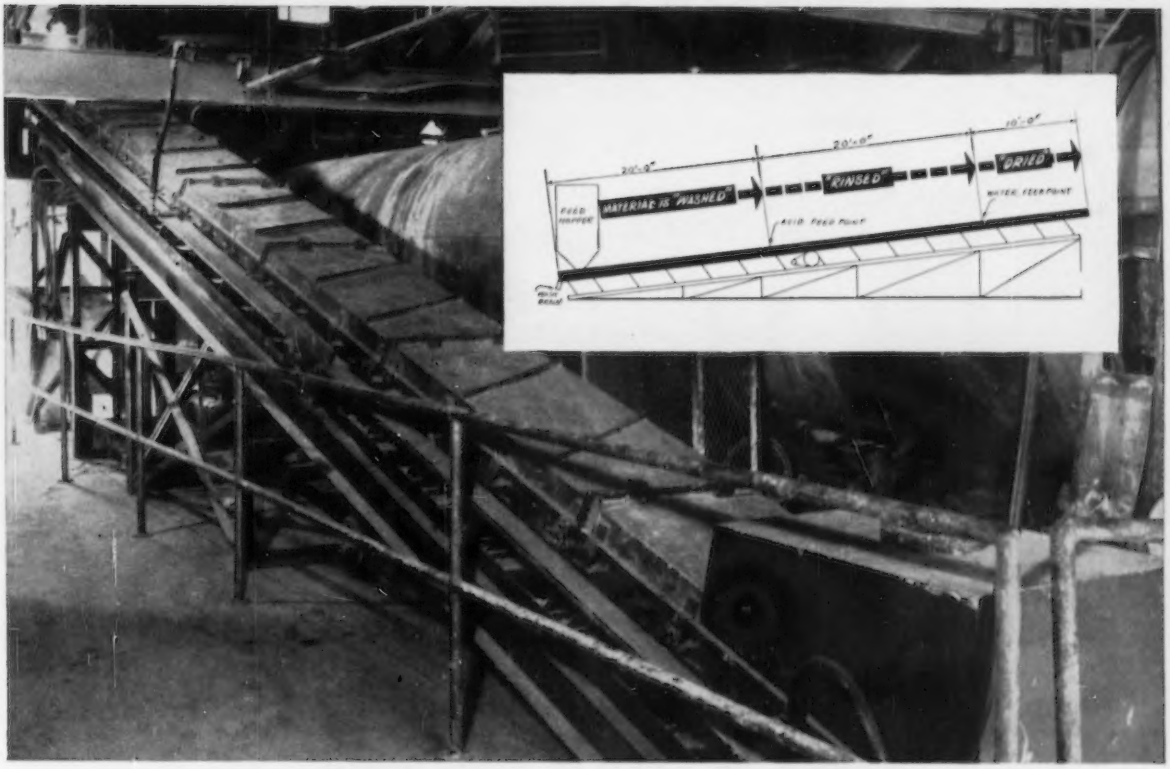

"Dy-Dee Service" for ORE— Leaching, Rinsing, Drying!

THE photo and diagram show you how ore is "washed-rinsed-and-dried"—*in one continuous operation,* for one of America's largest industries.

It used to be a three-step, batch process. First the material had to be leached in a big vat to reduce salt content. Then it was transferred to another tank for rinsing. Finally it was removed to another location for dewatering. It was a slow, cumbersome, expensive process.

Streamlining this operation was a cinch for Carrier engineers. In a matter of weeks they designed a 50′ Natural-Frequency Conveyor to do all three jobs, continuously. As the material moves onto the conveyor, a weak acid bath flowing down the pan leaches out the salt. Then it is rinsed with a water bath. Finally as it continues up the last 10′ of the conveyor, it is dewatered by vibration plus gravity.

There's no fussing with batches, no spillage, no costly manpower. What's more, there's a big saving in floor space and processing time has been cut by approximately two-thirds.

Agitation of a solid and a fluid, in a controlled continuous contact and separation cycle, is a natural for Carrier, who pioneered and specialize *exclusively* in Natural-Frequency Vibrating Equipment. How about your operation —aren't there some spots where heat-treating, quenching, cleaning or other processes can be combined? Tell us about them and let us see what we can work out for you.

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helps to create

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URANIUM

Ore milling specialists have settled upon acid leaching as the most practical and economical way to extract uranium values from ore concentrates. And as with so many other ore-leaching processes, sulphuric acid appears to be the best of the solvents, considering costs and availability.

So chalk up another 'headline' end-use for this most widely used of all acids! But this very broadening demand for sulphuric emphasizes the problem facing producers of the basic element SULPHUR. Search for new commercial sources goes on without let-up all over the world. This company is playing a leading role in this search.

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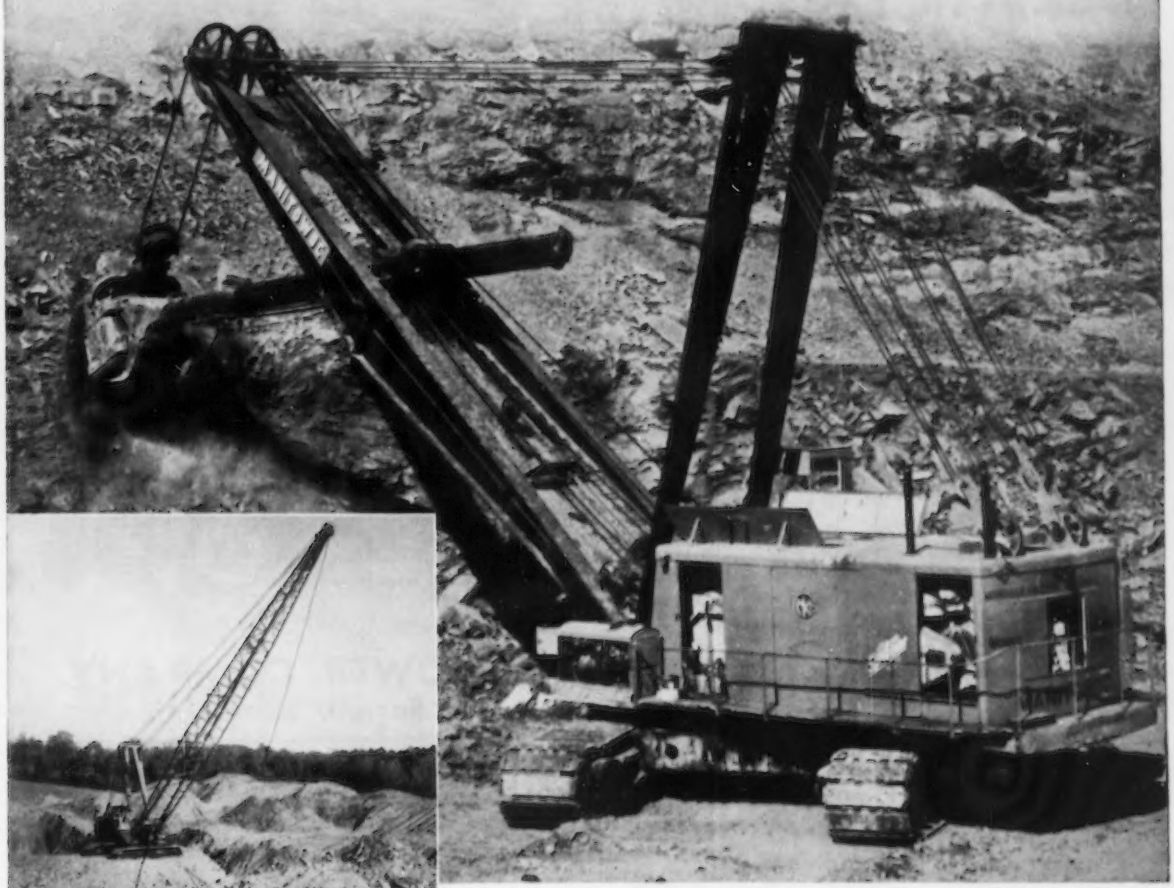

Left: E. N. Turner and Sons move more overburden per shift with their Manitowoc 4500 dragline near Harrisburg, Pa.

Above: This M-K Manitowoc 4500 shovel with high-lift boom makes fast work of stripping operation at Kemmerer, Wyo.

TORQUE CONVERTER FEATURES

- PRECISE CONTROL by either hand throttle or foot accelerator without slipping clutches or shifting speeds.
- BALANCED POWER LOAD for economy of operation — load requirements and engine horsepower automatically balanced.
- UNLIMITED SPEEDS without shifting since speeds and power are equal at all times.

MANITOWOC
SHOVELS 1-5 YD. Speed Crane CRANES 20-100 TON

Manitowoc 4500 Loads Out Greater Tonnage for Peak Production

Manitowoc 4500 shovels and draglines are boosting stripping and loading records in every mining area of the country. These powerful 4-5½ yd. excavators boost output substantially for profit-conscious operators who require the 4500's power and stamina.

High on the list of preferred features is the 4500's ability to take rock digging shock, shift after shift, with little downtime. The extra-strength, high tensile steel shovel boom has heavy, "bridge-built" side beams; tubular dipper stick turns in the saddle to absorb all digging stress and strain; positive-action torque converter matches engine power to the load; special 60' high-lift booms extend shovel digging and dumping ranges.

Gas or diesel drive with simple gear arrangement eliminates thousands of wires and connections necessary in electrically powered machines. There's no need for cumbersome trailing cable; power loss through prime mover and D.C. generator is eliminated; entire shovel can be disassembled, moved and set up in several days instead of weeks.

Look into *all* of the 4500's outstanding advantages before investing in your next shovel or dragline. See why the speed, mobility, simplified design and versatility of these mighty mining machines are making news wherever they're in use. MANITOWOC ENGINEERING CORP., MANITOWOC, WIS.

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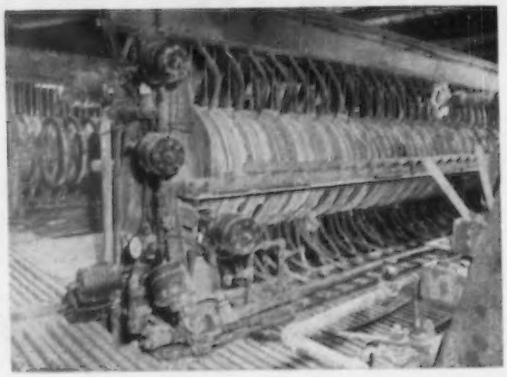
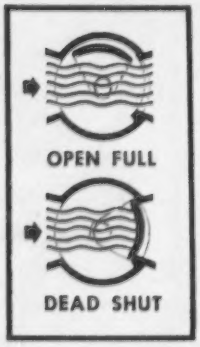
The EASY-OPERATING, NON-LUBRICATED VALVES FOR SO MANY METALLURGICAL SERVICE LINES!

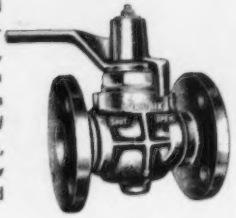


DeZurik Plug Valves with air operators on an Eimco Burwell filter.

The *exclusive* eccentric principle of DeZurik Plug Valves guarantees friction-free operation, dead-tight shut-off and low maintenance without lubrication for a wide choice of service lines.



Basically, DeZurik's eccentric principle consists of a resilient-faced metal-cored plug with an eccentric shape. Contact between the plug-face and the eccentrically-raised plug seat is made ONLY when the valve is fully closed. In opening the valve, the slightest rotation of the plug breaks the contact and it swings wide open in a quarter-turn—smoothly, easily, without friction! Tight sealing and easy operation are obtained *without lubrication!* In addition, the resilient plug-face *seals around* scale, dirt or other solids in the flow. Try a DeZurik Plug Valve on pulp, tailings, slurries, wash water . . . on *any* line where tight shut-off, easy operation and low maintenance are required. In sizes from ½" thru 20", in a full range of models and metals for almost every requirement.



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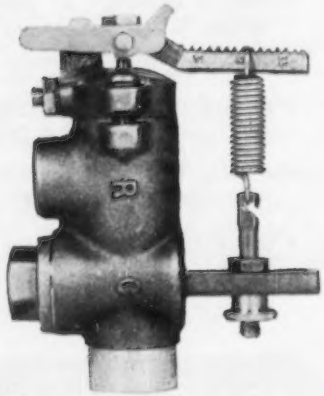

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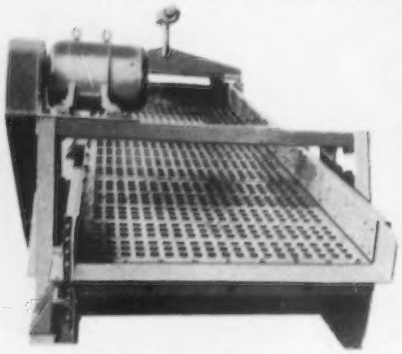

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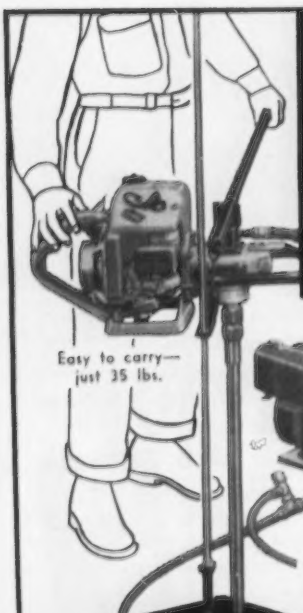

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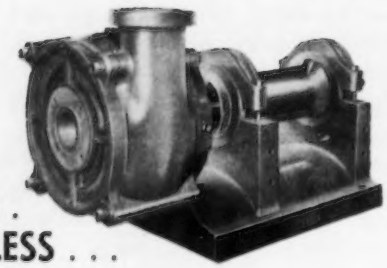

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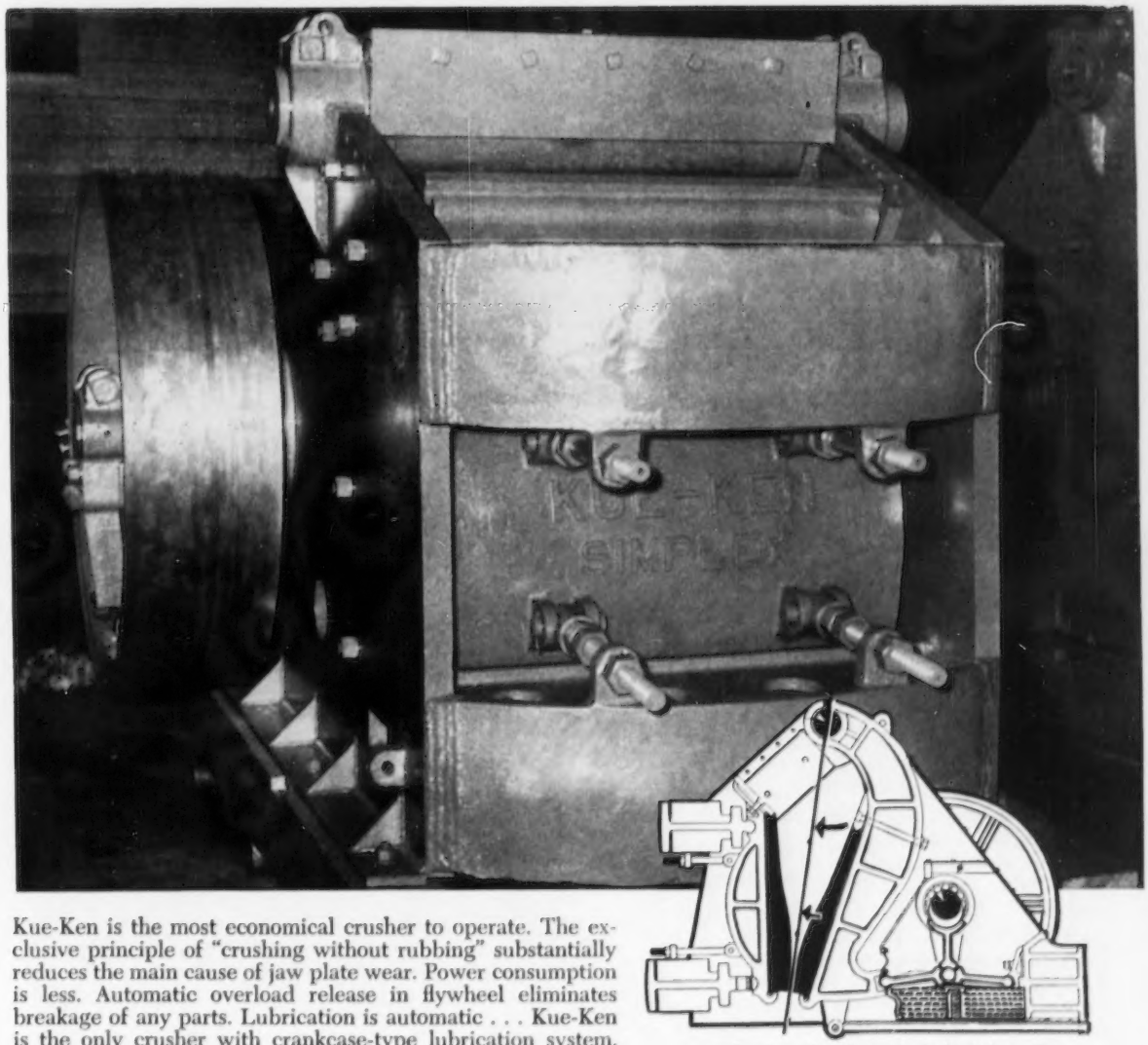

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● Rollway's *TRU-ROL* Steel-Cage Bearings afford wide latitude in balancing *dependable* performance, *long* life, and *high load* capacity against *moderate* cost. They rate high in any comparison on a cost-performance basis.

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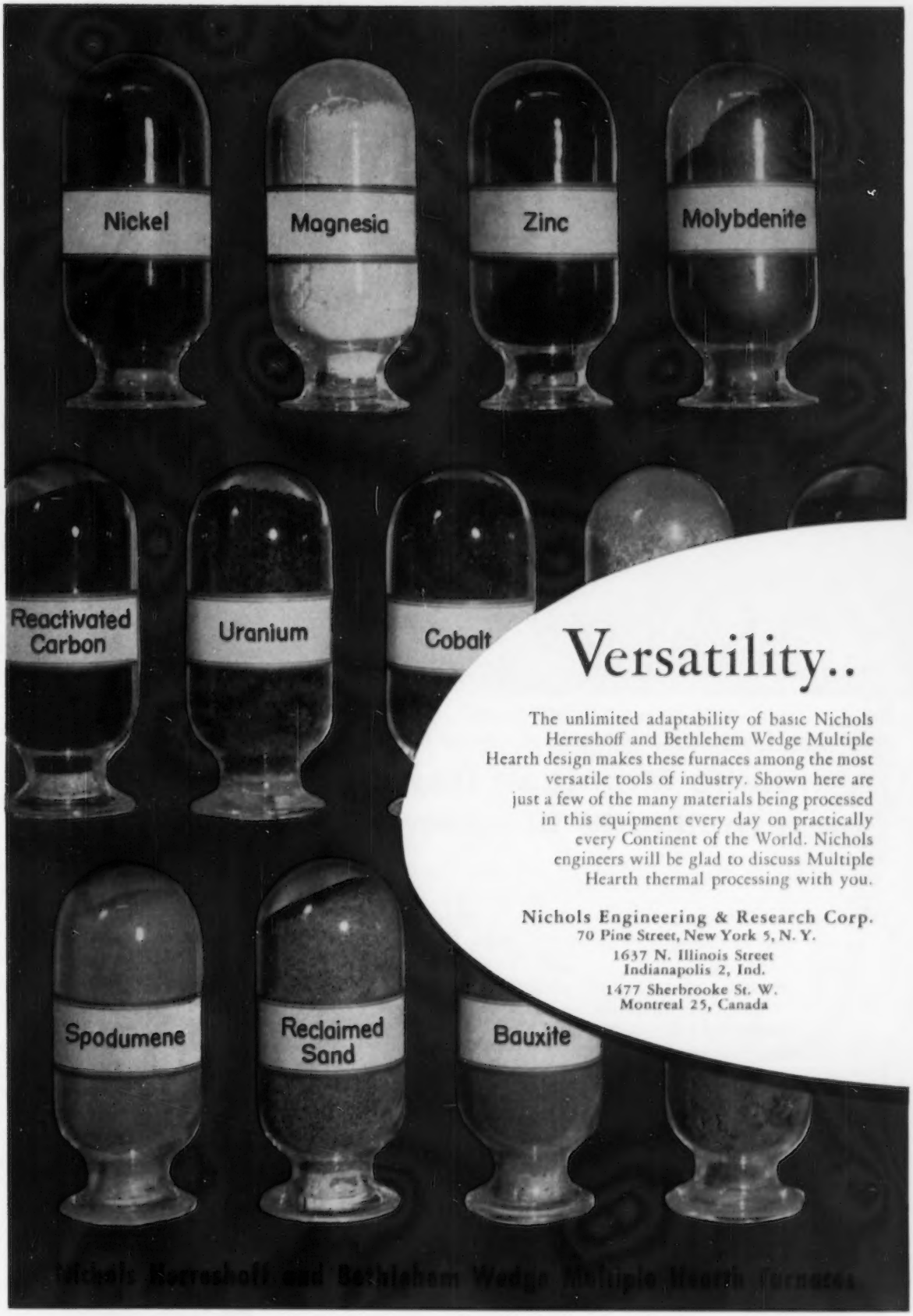

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The unlimited adaptability of basic Nichols Herreshoff and Bethlehem Wedge Multiple Hearth design makes these furnaces among the most versatile tools of industry. Shown here are just a few of the many materials being processed in this equipment every day on practically every Continent of the World. Nichols engineers will be glad to discuss Multiple Hearth thermal processing with you.

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Commutes 2 miles between Arizona pits . . .

Versatile Michigan pays for itself on a multitude of open pit jobs

This 2¼-yd. Michigan Tractor Shovel works at one of the biggest open pit copper mines in Arizona. At this location two pits are being mined: one a 4000 x 6000 pit up to 600-ft. deep; the other a new cut two miles away. Between these pits, the 27-mph Michigan commutes on its own power to handle a multitude of jobs.

Cleans up excess ore

Prior to blasting, the Michigan cleans up excess ore around the toes of the benches. It takes less than two minutes to put a heaping load into a 6-yd. dump truck. This efficient clean-up job makes for fuller breakout of material when blasting.

Delivers stemming material

No matter how hard the drillers try to dispose of the mud from the churn-type blast hole drills, trucks are often unable to get through to deliver stemming material. The 4-wheel drive Michigan easily works through the mud, delivers loads of stemming material to the powder loading points to keep shots on schedule.

Cleans up around shovels

When the crawler bulldozers come off the mine floor for repairs, the 133-hp Michigan does the clean-up work around the power shovels. Working on a new addition to the concentrating plant, the Michigan handles sand, aggregate and cement at the concrete plant. The Michigan also built a baseball diamond and part of an air strip by hauling and spreading the necessary material. Its big rubber tires even did the compacting!

A versatile work horse

With Clark torque converter, power-shift transmission and planetary-wheel axles, the Michigan Tractor Shovel delivers *more useable power and traction than you've ever seen on this type of machine.* It will handle amazingly heavy jobs—in addition to the routine assignments which affect the performance of the more expensive equipment, like power shovels, drills and rolling stock. For proof that the Michigan is in a class by itself, ask for an on-the-job demonstration. *You name the job.*

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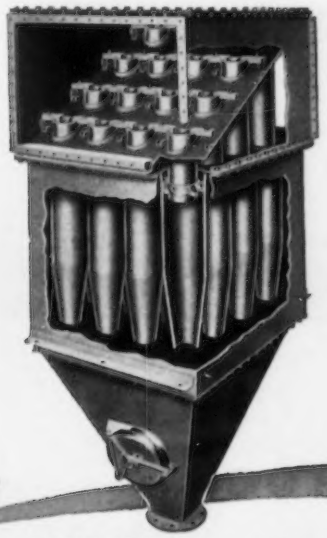
CLARK® EQUIPMENT

Before you buy *any* equipment for recovering dust . . .



COMPARE ALL OTHERS against MULTICLONE'S Multiple Advantages

Because the advantages of MULTICLONE are so clear-cut, so vitally important, so far-reaching in the savings they make, we urge you to make a factual unbiased comparison of MULTICLONE dust collection equipment against *any other* in the mechanical recovery field. Only by making such a comparison can you fully appreciate the major savings and greater performance you get by installing MULTICLONE Collectors!

COMPARE Recovery Efficiency!

It is a recognized fact that the separating efficiency of a cyclonic tube increases as the tube diameter decreases because smaller tubes generate greater centrifugal forces. The patented vane in the MULTICLONE makes the use of small tubes *practical* without complicated manifolding and permits compacting many small tubes into one simple, highly efficient unit. MULTICLONE's higher centrifugal forces throw out not only the large, medium and small particles, but also an unusually high percentage of the *extremely small* particles of 10 microns and less. Result—*more complete recovery of all suspended particles from the gas stream!*

COMPARE Space-Saving Compactness!

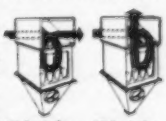
Plant space costs money—particularly at today's high construction costs. Because the MULTICLONE is more compact, size for size, it makes *really important* savings in space and plant costs. Note in the chart how the MULTICLONE requires substantially less space—*both in floor space and cubic space*—than any other unit of comparable capacity and performance. *This means vital savings in construction costs!*

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

COMPARE Dollar-Saving Adaptability!

Savings in space is just one of many ways MULTICLONE reduces installation costs. Because the shape of the unit can be readily varied (long and narrow, short and wide, or square) to fit available spaces, the MULTICLONE can often be tucked into odd corners and waste areas too restricted for other equipment.

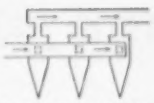
Moreover, inlet-outlet ducts can be varied—side-inlet side-outlet, or side-inlet top-outlet—to meet low headroom or restricted side clearance requirements . . . and the single-inlet single-outlet duct design permits greater flexibility and simpler installation. *These all add up to vital savings in installation costs!*



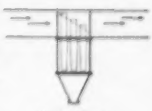
Side inlet, Side outlet ***Side inlet, Top outlet***

COMPARE All-Around Simplicity!

The MULTICLONE is simple and inexpensive to maintain because there are no highspeed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. In addition, the square, flat-sided shape of the MULTICLONE and its straight inlet and outlet ducts are far simpler to install and insulate. And since the recovered material from an entire bank of tubes is collected in a *single* hopper, it is much easier to service and maintain than the multiple hoppers of conventional cyclone units. *Here again, the MULTICLONE saves in many ways—all of them important!*

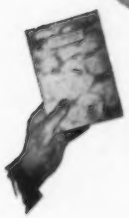


Conventional Cyclone



Multiclone

Whether your recovery installation is in a new structure or for modernizing present equipment, you will be far ahead by installing MULTICLONE Collectors. Our experienced engineers will gladly make helpful suggestions for simplifying your recovery problems. A letter, wire or call to our nearest office places this assistance at your service without obligation.



Send for Helpful Literature! This factual MULTICLONE literature explains the basic principles of cyclonic dust recovery and gives technical data helpful to anyone contemplating a dust or fly ash recovery installation. Write today for your free copy!

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Engineering & Mining Journal, the meeting place of mining men in all parts of the country, points the way to the solution of many mining problems through its Professional Service Section.

Why not tell one of these specialists about YOUR problem?

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The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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Mechanical **Electrical**
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State all particulars in first letter to file 4C

ATOMIC ENERGY OF CANADA LIMITED
Chalk River, Ontario

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Applicant must have a degree in Mining or Mechanical Engineering, with experience in quarrying and processing Rock Products. Must have a good knowledge of Plant Construction, General Maintenance and Material, handling equipment such as conveyors, etc. Age to 35, with at least 5 years experience in this type of work. Administrative ability must be proven by character references and former employers. *Leadership ability a must.* Some travel associated with position. Base of operation, Chicago, Illinois suburb.
Please send complete resume and small photo if available.

P 1388 Engineering and Mining Journal
520 No. Michigan Ave., Chicago 11, Ill.

WANTED EXPERIENCED MAN

TO ASSEMBLE AND TEACH OPERATION OF A FIVE YARD PAGE WALKING DRAGLINE MODEL 618 IN SOUTH AMERICA.
Contact: ST. JOHNS TERMINAL CO.
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REPLIES (Box No.): Address to office nearest you
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CHICAGO: 520 N. Michigan Ave. (11)
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POSITIONS VACANT

100 Civil Engineer Vacancies — The Michigan Civil Service Commission is currently recruiting to fill a large number of positions in the State Highway Department created by an expansion in the road construction program from $70 million in 1955 to $150 million in 1956. A comprehensive Engineer Trainee Program is offered to graduates of accredited engineering colleges. The program continues for 12 to 18 months including seven week assignments in each of the following: bridge construction, bridge design, road construction, road design, road surveys, maintenance, planning and traffic and testing and research (soils). One hundred and ninety-one persons have entered this program in the last seven years. One hundred and thirty-two remain. The figures speak for themselves. Job opportunity, promotion, 40 hour work week, security, social security, state pension plan, vacation, sick leave and many other benefits generally available only under a progressive civil service system are yours when you work for the Michigan State Highway Department. Salary for the engineer trainee program starts at $4600 plus $20 weekly expense allowance while on most training assignments with 6 month increases to $5200 in 18 months. First promotion brings salary range with maximum of $6800. Next promotion to project engineer carries salary at maximum of $8150. Write for application for Engineer Trainee I to Michigan Civil Service, Recruitment and Placement, Lansing 13, Michhigan.

Exploration — Mining Engineer. Position with exploration division of large mining company. Desire man with five to ten years' experience in physical exploration and mine evaluation work. Must know exploration drilling, tonnage and cost estimating, and be able to prepare finished reports. Submit resume of education, experience, and personal history. Location, Western U.S. Salary open. Reply P-1570, Engineering & Mining Journal.

PROJECT ENGINEER WANTED

Graduate Mining, Metallurgical, Chemical or Mechanical Engineer, preferably 25 to 35 years old, wanted by medium size progressive heavy machinery manufacturing company located in Southeastern Pennsylvania. To assist in design and preparing for market of various lines of equipment used in mineral dressing, heavy chemical, cement and rock products industries. Must have had engineering and field experience, and be willing to work on drafting board, travel and do field service. Opportunity also exists for a properly qualified individual, eventually to become a sales engineer. Salary open.

P-7533 Engineering & Mining Journal
330 W. 42nd St., New York 36, N. Y.

POSITIONS VACANT

Junior geologist and junior mining engineer for lead-zinc mine in Northern Mexico. Knowledge of Spanish helpful but not essential. Excellent climate and living conditions. Please give full details. P-1419, Engineering & Mining Journal.

Immediate opening on sales staff of internationally known manufacturer of tunneling machinery with headquarters in Chicago. Prefer graduate engineer of some experience with tunnel contractor. Willing to travel. Address P-1360, Engineering & Mining Journal. Will arrange for interview.

POSITIONS WANTED

Geologist-Engineer, 31, family, sound education, 5½ years field and mining geology including 3½ years underground engineering and mine operation, energetic, capable, adaptable, seeks unusual or interesting opportunity in exploration, research, or operations with aggressive firm, employed. PW-1264, Engineering & Mining Journal.

Graduate Chemist, 36, family, 3 yrs experience in smelter lab in South America, qualified assayer copper lead silver gold, speaks Spanish, employed, available Sept. Oct., desires resp. pos. abroad. PW-1373, Engineering & Mining Journal.

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Economic Geologist/Petrographer, Ph.D., well prepared in his specialties and allied fields, seeks position in research, exploration or teaching. Very good references. PW-1561, Engineering & Mining Journal.

Mining Engineer—with diversified background in production-cost. Experience to oversee exploration, evaluation, layout, development and operation of deep and surface mining. Trained in mining, civil & industrial engineering, business administration and industrial relations. Ability to direct, organize, analyze and execute plans for new mines, improve performance. Make appraisals, economy, capital cost, operating and special project reports. Abreast of latest methods and machines. Interested in middle or top echelon responsibilities in management-operation with expanding firm that must gear to peak productivity. PW-1502, Engineering & Mining Journal.

Mining Engineer-Superintendent — graduate, six years' experience with major U.S. gold producer. Experience in underground production, shaft sinking, mineral-land evaluation, exploration drilling and mill design. Married, children. Willing to go abroad. Available June 15. PW-1557, Engineering & Mining Journal.

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Excellent opportunity offer preferably for metallurgical or mechanical engineer who has done market research work on potential for metals or metal products; to take charge of market research work on non-ferrous metals in large firm located in New York City. Work will be on lead, zinc, bronze, nickel, titanium metal and new products.

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330 W. 42 ST., NEW YORK 36, N.Y.
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(Classified Advertising)

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New, in original packing case. Model 1R—40, complete with shank and bit punch, shanking devices, dies, dollies, punch pins and various other parts. Priced at approximate half of present cost. Packed for export.
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1—8P 125 Connor, Vane, Air Driven
1—21 Joy Axivane, Model 1000, 4700 cfm at 50", 5 HP electric motor.
1—6" diameter Jeffrey Aerodyne with 100 HP motor.

CLASSIFIERS, RAKE
1—Eimco Simplex 50" x 17'
1—Eimco Duplex Model D, 4'6" x 18' with 3 HP motor
1—Eimco duplex, 6' x 20, like new with 3 HP ind. motor.
1—6' x 27' Duplex, Dorr DSFX
1—Dorr Duplex, 6' x 19'6", type C excellent
1—Dorr Model DSD Duplex, 8' x 23'6"

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1—30" x 14'9" Wemco, Simplex, with right angle speed reducer, excellent.

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1—990 cfm, I.R. type 10, 2-stage stationary, size 20 and 12 x 16, with 200 HP motor.
1—550 cfm I.R., Imperial type 10, with 100 HP motor.
1—I.R. 255 cfm, type ERJ with 75 HP ind. motor.
1—10 x 20 Wheeling, force feed, No. 5
1—10 x 21 Rol.er bearing, Telsmith, force feed
1—6 x 12 Wheeling
1—D.F.C. Size #2—3½" x 4½"

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1—26" Telsmith intercone with 15 HP G. E. motor
1—3' Traylor TY with large amount of new parts.
1—10" Massco Gy-Roll Reduction, like new.

CRUSHING ROLLS
1—Set Davis 36" x 16"
1—Set Allis Chalmers 14" x 30"
1—Set Denver Engineering, 14" x 28"

DUST COLLECTOR SYSTEM
1—Rote-Clone, size 12 complete with 15 HP motor

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1—40' centers, vertical belt-type with 12" x 7½" x 6" buckets.
2—18'8" centers vertical with 4" x 8" buckets.

FEEDERS
2—FO #5HM4—36" x 72" Grizzly Pan with liners.
1—3' Apron with 6'8" centers mtd. on "I" Beams
1—Hardinge size 'D' Constant Weight "Feedometer"
1—Lime eccentric type with 50 lb. tapered storage bin, Ziegler type.

FEEDERS, REAGENT
2—New Model E Clarkson with 18-8 stainless steel tank.
1—Dry belt type 12" belt 50" centers
1—Belt type, Lime
1—Denver #12, Disc type
2—#12 Duplex wheel type

FILTERS, DISC
1—American 6'2" disc, complete
1—Oliver-American 4', 4-disc
1—Eimco 4', 4-disc with all accessories

FILTERS, DRUM
1—8' dia. x 4' Oliver
1—3' dia. x 4' Oliver

FLOTATION MACHINES
1—4-cell #24 Denver Sub-A Rougher Machine
1—4-cell #18 Denver Sub-A
2—8-cell No. 18 Denver Sub-A's equipped with wood cells
1—5-cell Fagergren, 36" cells
1—3-cell #15 Denver Sub-A.
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1—Model B-311, 3-drum with 25 HP G. E. motor
1—Sullivan 2-drum Model CF-211, 50-60 HP
1—I.R. 10NN1H Electric

HOISTS, TUGGER
4—Joy LF-112, 75 HP, 2000 lbs. rope pull, 125 fpm
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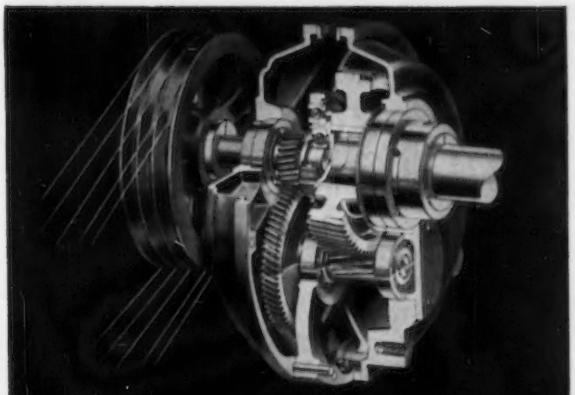


Here's why AMERICAN SHAFT-KING is the pace setter among speed reducers

- **THEY'RE Versatile**—built for use with motors of any make, any type, any age.
- **Easily Installed**—no special shafts or shaft extensions needed. Also come with exclusive tapered hub construction.
- **Made in two ratios**—13:1 and 20:1—for speeds from 5 to 154 R.P.M. and seven sizes from ¼ to 42 H.P.
- **Equal efficiency** on either horizontal or vertical mountings.
- **Precision-Built**—Shaft-Kings are built from components made on equipment chosen solely for this purpose, using techniques unsurpassed anywhere . . . comply with A.G.M.A. standards throughout.
- **Shaft-Mounted**—no special supports or foundations needed; space is saved.
- **Proven Performance**—over 100,000 American Speed-Reduction Drives are in use in every industry, in thousands of companies, large and small, throughout the world.
- **Immediately Available**—from distributor stocks everywhere.

In other words, American Shaft-King gives you

POWER AT THE SPEED YOU NEED

Write today for complete catalog including selection tables.

The American Pulley Company
POWER-TRANSMISSION DIVISION
4210 Wissahickon Ave. • Phila. 29, Pa.

... Don't overlook this speedier Power Drive

that takes the work out of pipe threading, cutting, reaming...

RIDGID

400A with wrenchless *SPEED CHUCK*

Lots of ready power turns pipe, conduit or rod for your hand threaders, cutters, reamers—even up to 12" geared tools with drive shaft. New Speed Chuck opens and closes easily, guaranteed to grip tight forward, reverse; jaws have replaceable insert teeth for longer life. Light, compact, portable—built for years of service. Bench, stand and wheelstand models. See and try the 400A—at your Supply House!

RIDGID 504
quick-opening threader for power drive use—self-contained dies for 1" to 2" pipe or conduit.

"Threaded Pipe—It's Tight—It's Best—Costs Less"

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company • Elyria, Ohio, U.S.A.

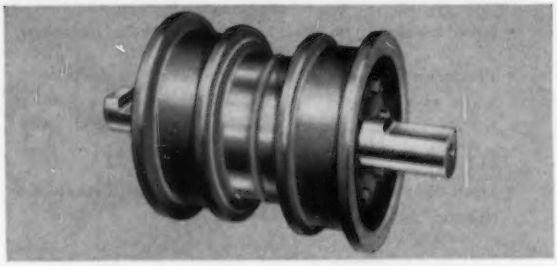
Do you believe one make of parts is as good as another?

Take track rollers. You can buy substitutes that look on the outside like Caterpillar originals. But a Cat-built track roller has deep hardened rims of forged steel. Forging keeps rims free from the accidental defects often found in castings. The roller shaft is one-piece and induction-hardened. The seals are self-aligning, of double-tanned leather to *really* keep lubricant in, water and dirt out. You're *sure* of extra wear, extra life —on the toughest jobs.

With substitute parts, can you be sure of anything?

See your dealer's Parts Representative—better get Caterpillar original parts every time.

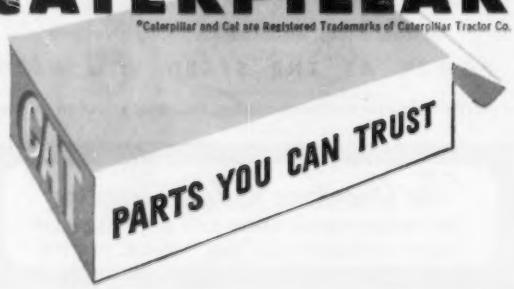
Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

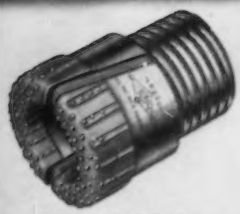


Steel for CAT* rollers is pretested, forged in special Caterpillar-owned dies, precision-machined, scientifically heat-treated and carefully inspected. Why settle for anything less?

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.





TRUCO CORING BIT

TRUCO CONCAVE BLAST HOLE BIT

TRUCO PILOT BIT

TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS

TRUCO STANDARD OIL FIELD BIT

FINEST QUALITY DRILL BORTZ

1910 *Our 46th Anniversary* **1956**

man on the wing

Great things were happening in aviation 46 years ago when we launched the idea of scientifically selected industrial diamonds and set up our little factory to make the diamond tools that were to be so vital to aviation.

Louis Bleriot had won $5,000 offered by London Daily Mail for the first airplane flight across the English Channel. Piloting his 24 H.P., 450 pound monoplane to the dizzy height of 250 feet, he had spanned the 21 miles of open water in 37 minutes. The challenge echoed across the Atlantic and 1910 saw a brilliant parade of dramatic "firsts."

Glenn Curtis won $10,000 offered by New York World in a 150 mile race with a train. Charlie Hamilton won $10,000 offered by New York and Philadelphia newspapers for flying a round trip between those cities in one day. Walt Brookins won $5,000 offered by Atlantic City Aero Club for reaching a height of one mile.

Ely took off from the deck of a cruiser and flew two miles to Norfolk in the first ship take-off flight. Phil Parmalee got $5,000 for flying five bolts of silk from Dayton to Columbus, Ohio, in a store publicity stunt—the first merchandise shipped by air.

Another first in those early years was Engineered Diamond Tools followed, later, by Truco Engineered Diamond Bits containing the finest selected diamonds, hand set to bring each sharpest cutting face to the work. In virtually every major drilling operation in the world these bits are now famous for fast, accurate and dependable penetration in every formation and for their ability to reduce rig time and footage costs. May we send you a copy of the Truco Diamond Bit Catalog?

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

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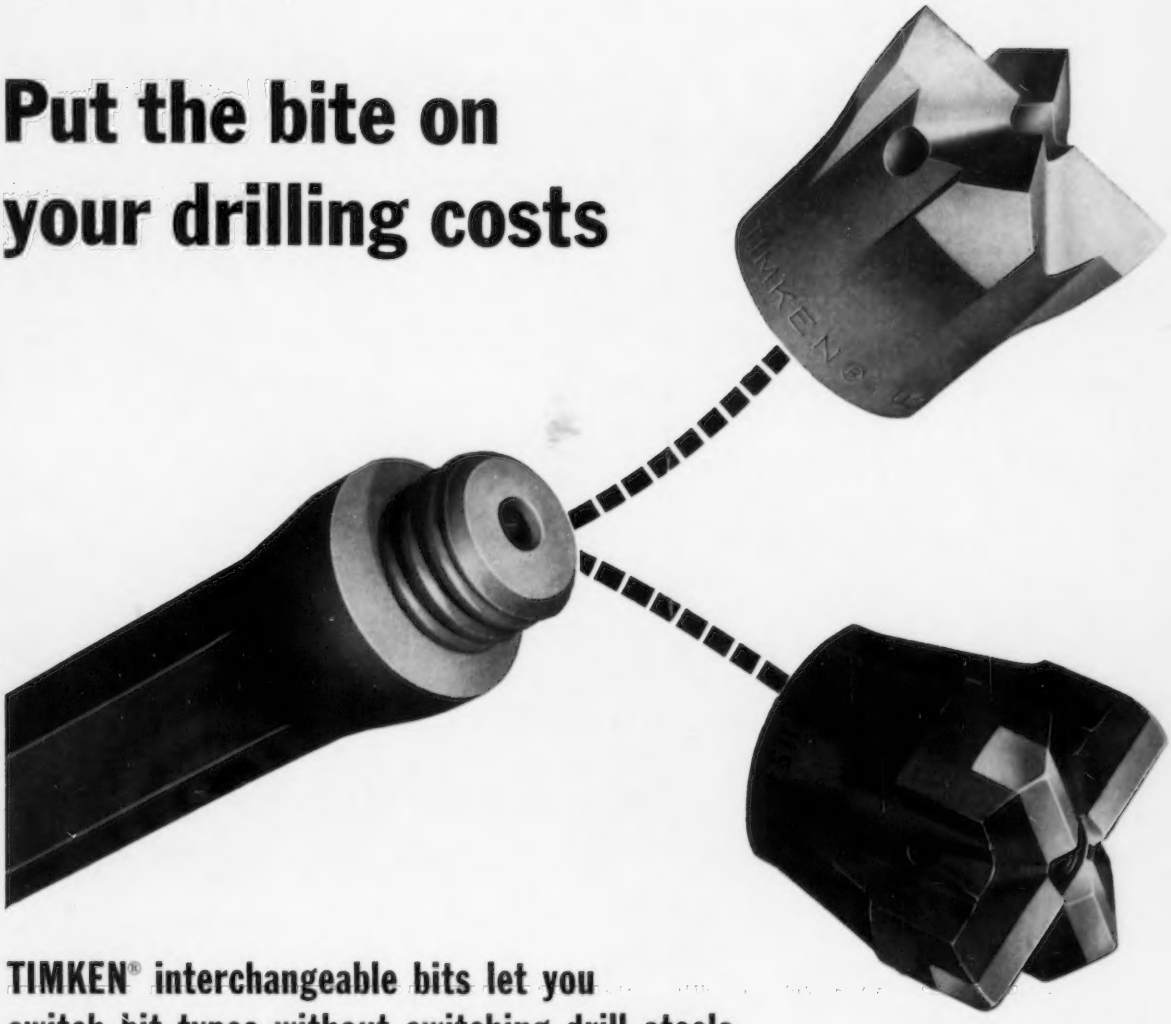
575 Langlois Avenue, Windsor, Ont., Canada

Put the bite on your drilling costs



TIMKEN® interchangeable bits let you switch bit types without switching drill steels

DOZENS of different Timken® rock bits—both multi-use and carbide insert—fit the same drill steel. They can be changed fast, right on the job. Just screw one type off, screw another right on the same steel. No need to switch drill steels at the same time. Your drillers can quickly switch to the most effective and economical bit as the ground changes. And you can cut expensive drill steel inventories.

Timken rock bits are made from electric furnace Timken fine alloy steel. And Timken bits have a shoulder union specially developed by the Timken Company that prevents drilling impact from damaging threads.

If you have a drilling problem, let our rock bit engineers tackle it. Use their more than twenty years of experience to your advantage. They'll welcome the opportunity to help you put the bite on your drilling costs. Just write The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

WHERE YOU CUT COSTS WITH TIMKEN MULTI-USE BITS

Most economical for ordinary ground. With correct and controlled reconditioning, they give the lowest cost per foot of hole when full increments of steel can be drilled.

WHERE YOU CUT COSTS WITH TIMKEN CARBIDE INSERT BITS

Give highest speed through hard, abrasive ground. Also most economical for constant-gauge holes, small diameter holes, very deep holes.

TIMKEN

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...your best bet for the best bit... for every job